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1885

OFFICIAL
GUIDE
TO THE
INTERNATIONAL
INVENTIONS
EXHIBITION



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AT THE
INTERNATIONAL INVENTIONS EXHIBITION, 1885.

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(ENGLISH).

CEAD MÌLE FAILTHI

(CELTIC).

FAILTE

(GAELIC).

SALUT

(FRENCH).

WILLKOMMEN

(GERMAN).

WELKOM

(DUTCH).

HILSEN OG VELKOMST

(DANISH).

SALVE!

(ITALIAN).

BEN VENUTO

(VENETIAN).

XAIPE

(GREEK—*Singular*).

XAIPÉTE

(GREEK—*Plural*).

ՈՂԶՈՅԷ

(ARMENIAN).

حور آء

(HINDUSTANI).

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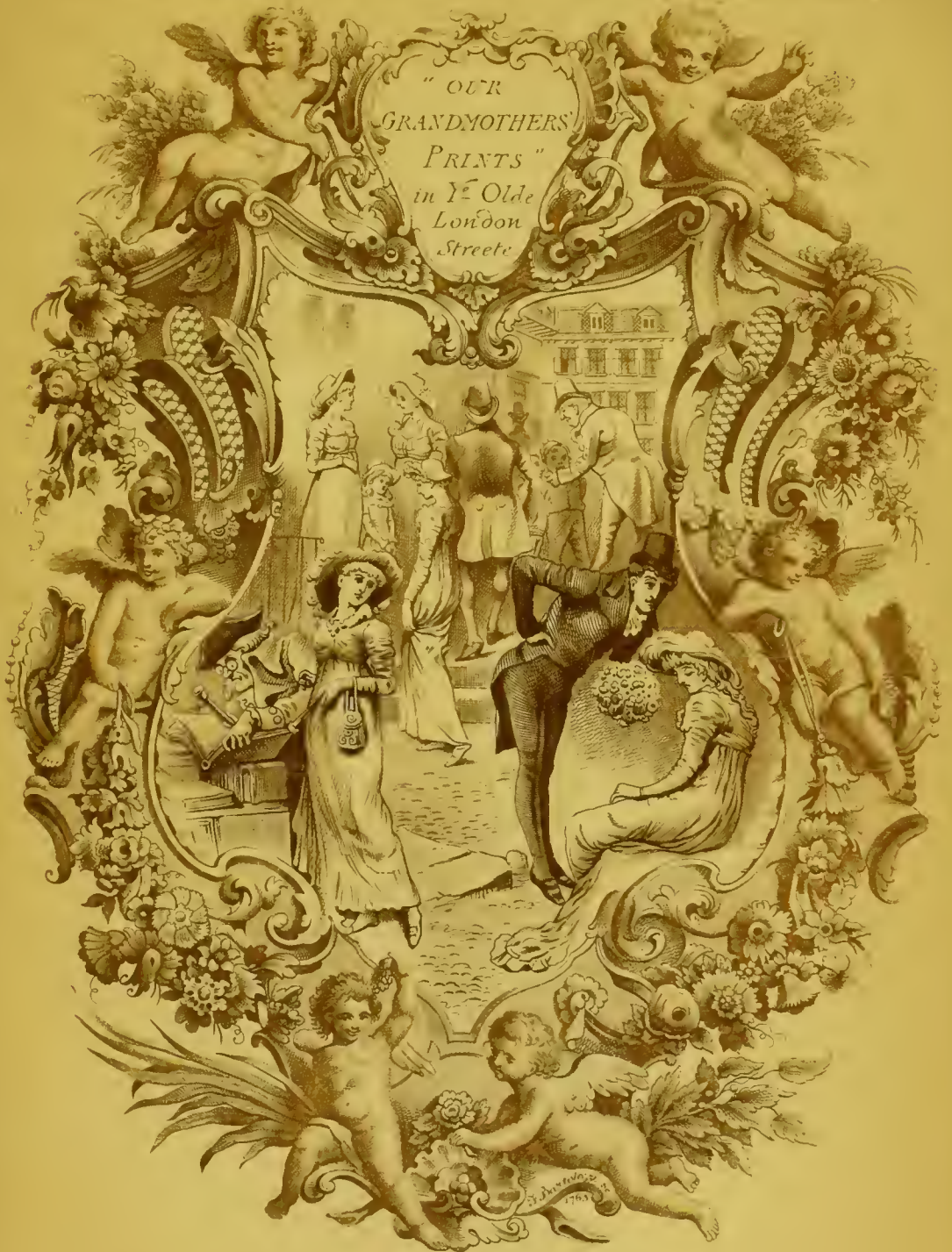
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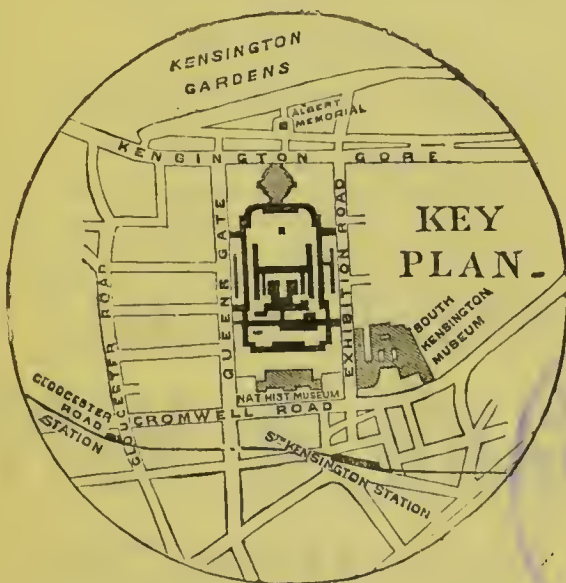
TRELOAR'S LINOLEUM IS WELL SEASONED, AND THEREFORE WEARS H



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3

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WILLIAM CLOWES AND SONS, LIMITED,
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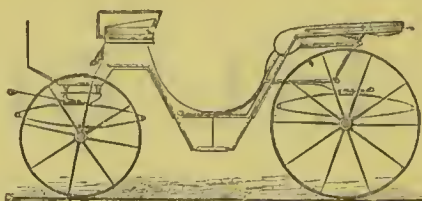
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 " 1862.
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THIS EXHIBITION.

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OFFICIAL GUIDE

TO THE

INTERNATIONAL INVENTIONS EXHIBITION.

INTRODUCTION.

ORIGIN AND SCOPE OF EXHIBITION—CLASSIFICATION OF SUBJECTS—
ACCOUNT OF PROGRESS MADE IN EACH GROUP SINCE 1862—OLD
LONDON—EXECUTIVE COUNCIL.

THE intention to hold an International Inventions Exhibition in the year 1885 was originally expressed by H.R.H. the Prince of Wales at the close of the Fisheries Exhibition. His Royal Highness on that occasion specially referred to the passing of the New Patent Acts, which were designed to be useful to the poorer classes of inventors, and expressed the opinion that under the circumstances much good might result from the holding of an Exhibition which should illustrate the progress of invention since the time of the last Great International Exhibition in this country, in the year 1862.

Origin of
the Exhi-
bition of
Inven-
tions.

It was afterwards determined to add the subject of Music, just as in the previous Exhibition Education had been coupled with Health. In the case of Music, however, there was not the same necessity for limiting the epoch, for no special Exhibition relating to Music had as yet been held in this country, and it was consequently determined to admit all instruments of the present century, in addition to a Loan Collection of Instruments, Printed Music, &c., of any date.

Musical
Exhibi-
tion.

Inasmuch as the space available for the display of Inventions was strictly limited, and that, too, in spite of large additions to the buildings in use last year, it was necessary to impose some limitations upon the area to be given up to certain classes of objects. Accordingly those inventions which were well represented in the Smoke Abatement, the Fisheries, and the Health Exhibitions, as well as in the Annual Shows of the Royal Agricultural Society, have in the present Exhibition comparatively little space allotted to them.

Limita-
tions to
scope of
Inventions
Exhibi-
tion.

Even with these limitations the applications for space were so large that the most careful scrutiny had to be exercised by special Committees appointed for the purpose, and eventually only those inventions which appeared to be of sufficient public interest or importance were admitted.

The system of classification in the Inventions Exhibition is based to a large extent upon that adopted by the Patent Office; while the arrangement of the Musical section is founded upon the classification adopted by the Juries in 1851, and there has been added a group for Music Engraving and Printing, and another for the Loan Collection.

Classifica-
tion of
Exhibits.

The following is a list of the subdivisions.

For Contents, see p. 3; View of Gardens, p. 41; Ground Plan, between pp. 48 and 49; View of Old London, p. 56; Index, p. 67; Method of reaching Exhibition, pp. 72-77,

**Agri-
culture
and Horti-
culture.**

Group I. relates to Agriculture and Horticulture, and comprises such important inventions as portable steam engines, steam ploughs, mowing, reaping, and hay-making machinery, sheaf-binders, corn and seed drills, chaff and turnip cutters, grist mills, dairy and horticultural appliances, and innumerable other labour-saving machines, all of which have either been invented or developed since 1862.

**Mining
and Metal-
lurgy.**

Group II. comprises Mining and Metallurgy. In this department inventors have been so busy during the last twenty-three years, that it may safely be affirmed that during this epoch most of our metallurgical processes have been revolutionised, while the labour-saving appliances used in every branch of mining have been immensely developed. The latter department comprises such inventions as deep-boring and rock-drilling machinery—including the now famous diamond borers—the nitro explosives such as dynamite, blasting gelatine and gun-cotton, which have rendered such incalculable services in rock-blasting, shaft-sinking, and tunnelling,—coal cutters and coal-breaking appliances, including in the latter the lime cartridge, which has proved itself an invaluable substitute for explosives in firing mines—underground hauling and lifting machinery—and apparatus for the breaking, pulverising, and sorting of ores and other minerals. Amongst the most important appliances in this department must be mentioned the miners' safety lamp, several varieties of which are exhibited.

**Metal-
lurgy.**

Amongst metallurgical inventions we need only mention the Bessemer steel process, the Siemens open-hearth process, and the Gilchrist Thomas, or so-called basic system for the utilisation of ores contaminated by the presence of phosphorus, in order to show what has been accomplished in the period under review. In addition to the exhibits relating to the metallurgy of iron, there will be found in this section of the Exhibition many samples of new alloys, examples of processes relating to the metallurgy of gold, silver, aluminium, copper, zinc, and lead, also specimens of improved furnaces, and of improved methods of utilising bye-products such as slag and the ammoniacal products of coke ovens.

**Engineer-
ing Con-
struction
and Archi-
tecture.**

Group III. relates to Engineering Construction and Architecture, and embraces many exhibits relating to the design, construction, drainage, and ventilation of houses, factories, and public buildings. New materials for construction are largely represented, and this section also embraces many drawings and models of improved systems of bridge construction, docks, breakwaters, harbour works, and tunnels. The permanent way of railroads, the construction of roads and streets, mechanical methods of excavation, foundation, sinking, and pile-driving, and the construction of lifts and accumulators, naturally occupy prominent positions in this group.

**Prime
Movers,
and means
of distri-
buting
their
power.**

Group IV. embraces the important subjects of Prime Movers, and the distribution of their power, and comprises steam engines in all their classes, gas, hot-air, and water-pressure engines, water wheels and turbines, steam generators, and their fittings and accessories, shafting, driving gear, belts, and ropes for the transmission of power, and the modern methods for the distribution of hydraulic power.

The improvements in the construction of steam engines since the year 1862, have reference chiefly to the economy of fuel. In that year an expenditure of four pounds of coal per indicated horse-power per

hour was regarded as an extraordinary result, to be attained only in the best steam engines, whereas at the present day triple expansive marine engines accomplish the same work on a consumption of 1'4 pounds. This end has been attained by the use of steam of higher temperature, and therefore pressure, worked at high ranges of expansion in compound and even latterly in triple compound engines.

The gas engine is one of those inventions which belong to the period covered by the Exhibition; working as it does without a boiler, and requiring but little attention, it has attained great popularity during the last few years. Several types of this class of prime mover are exemplified in this group.

The important subject of Railway Plant is included in Group V. **Railway Plant.** Looked at not merely from the commercial aspect, but also from the point of view of the safety of human life, it is probable that no other department of the Exhibition exceeds in interest this group. The most remarkable improvements which have taken place during the last twenty-five years are the introduction of steel as the material for the construction of rails, tires, axles, and many parts of locomotive engines—continuous brakes applied to each wheel of a train in place of the old system of hand-power brakes applied to every eighth or tenth vehicle—and lastly, the development of the block system for signalling and regulating traffic. Thanks to these improvements, all of which are well represented in the Exhibition, the percentage of loss of life is at the present time less than one-third of what it was twenty years ago.

Group VI. embraces common Road Carriages and Bicycles and Tricycles. **Road Carriages, Bicycles and Tricycles.** It contains a very large assortment of the most modern examples of carriages, cabs, and carts; but perhaps the most remarkable feature in this section of the Exhibition is the immense development in the manufacture of bicycles and tricycles which it illustrates. These machines, though dating originally from the commencement of the present century, owe their present form exclusively to the improvements of the last dozen years. Their mechanical features present much that is interesting, the wheels especially being marvels of strength and lightness. It seems probable, from an inspection of some of the samples exhibited, that these machines will soon find a larger field of employment than they have hitherto done. On the well-paved streets of towns, and on the better class of country roads, there is apparently no reason why they should not to a great extent supersede the use of the horse and cart for the purposes of retail tradesmen.

There is no department of the Exhibition of greater practical interest to this maritime community than Group VII., which deals with Naval Architecture. **Naval Architecture.** During the last quarter of a century the improvements which have been effected have resulted in the complete transformation of the practice of shipbuilding.

The almost universal adoption of steam as the means of propulsion, the change from wood to iron, and from iron to steel, as the material for construction, briefly indicate a few of the larger features of this transformation; but the progress effected in the details of construction and of the propelling machinery are scarcely less remarkable. A better knowledge of the laws governing the resistance to motion of floating bodies, coupled with the enormous development in the power of engines,

due to the successful introduction of steam of very high pressure, has enabled speeds of 20 knots to be obtained, whereas twenty-five years ago twelve knots was an unusual speed. The enormous economies effected in the fuel consumption of engines have enabled vessels to carry coal supplies for voyages which were formerly thought wholly unsuitable for steam vessels. An enterprising Liverpool shipowner not long since declared that fuel has now become one of the minor expenses of steamers.

Amongst the improvements effected in the details of construction of the hulls of vessels, we may mention the introduction of continuous iron decks and double bottoms, which contribute so much to strength and rigidity, and actually convert the vessel into a species of floating box girder. Another most important improvement is the systematic subdivision of the hull by means of water-tight transverse bulkheads in connection with water-tight decks, and carried up to such a height that, in the event of a compartment getting pierced and flooded, and consequently to a certain extent submerged, the water will not be enabled to pour over the head of the bulkhead into the adjacent sound compartment. The proper methods of designing and constructing bulkheads have not till the last few years been properly understood, or else have in many cases been systematically neglected. The improvement latterly observable in this respect is due no doubt largely to the influence which the Admiralty was enabled to bear on private ship-owners, by forming a register of merchant steamers available for war purposes. It was at one time thought that the proper subdivision of the hulls of steamers, which is so essential for their safety in the event of grounding or collision, was incompatible with the economical working for mercantile purposes; but it is satisfactory to know that this belief is steadily losing ground. In war-steamers, of course, the principle of subdivision is carried out with a degree of minuteness which would be impossible in the mercantile marine.

In the fittings of ships,—the accommodation provided on board the passenger-steamers on all the great lines, and the mechanical methods of steering, stowing and discharging cargo, pumping, working guns and turrets, raising ammunition, weighing anchors, &c.—the improvements effected have been not less remarkable than in the other branches of Naval Architecture.

Great as have been the advances made in the practice of shipbuilding, they have been fully equalled, and in the main inspired, by the progress made in the comprehension of theoretical problems. It is true that it is now just half a century since Scott Russell commenced to raise shipbuilding from the position of a merely empirical practice to that of a scientific art, but the last half of that period has witnessed a wonderful development of our theoretical knowledge of the laws of resistance to the motion of floating bodies, and the other problems involved in propulsion,—of the scientific principles of construction which enable us to secure the maximum of strength,—and, lastly, of the doctrines and the methods of calculating stability, which are now so far perfected that the naval architect is able to predict with perfect confidence the behaviour as regards stability of even perfectly new types of vessels under all conditions of draught and stowage.

The great results briefly indicated above are largely due to the

influence and example of the Admiralty, which has led the way in adopting new systems and materials of construction, to the enlightened management of the great classification societies, of which the most important is Lloyd's Registry of British and Foreign Shipping, and, lastly, to the unequalled opportunities offered by the Institution of Naval Architects for the collection, the discussion, and the recording of results.

Group VIII. is devoted to Aeronautics, and contains models of proposed flying machines and improvements in balloons. **Aeronautics.**

Group IX. is given over to Textile Fabrics, the most important of British manufacturing industries, and contains specimens of improvements in the machinery used in the manufacture of cotton and linen goods, woollens and worsteds, hosiery and carpets. The improvements introduced into this class of machinery since the year 1862 relate for the most part to the details of mechanism and the perfection of workmanship. In principle the various classes of machines are the same as they were a quarter of a century ago, but the improvements referred to have enabled the value of our exports of textile goods to be increased from the 70 millions at which they stood in 1862 to 120 millions, the figure attained last year, and that, too, in spite of the fact that the wages of our operatives are higher and their hours of labour shorter than those of any other country in Europe. The further improvements which will probably be introduced in the near future into this branch of industry refer to the amelioration of our native designs for patterns of cloth, and in our chemical and mechanical processes for the finishing of fabrics. **Textile Fabrics.**

Under Group X. are classified Machine Tools of various descriptions for the working of metals, wood, stone, pottery, and even paper and dough. To the mechanical engineer this section of the Exhibition will be one of great interest. The principal novelties in this group are to be found under the heads of wood working machinery, milling tools, and emery wheels. In other respects the machine tools of to-day, though greatly improved in details, are substantially identical in principle with those of 1862. **Machine Tools.**

Much progress has been made during the quarter of a century in the development of Hydraulic Machinery, which is classified under Group XI. It is true that, prior to the last great Exhibition, Sir William Armstrong had introduced the well-known system of transmitting water-power through pipes by means of the pressure generated in accumulators for the purposes of working dock-gates, cranes, swing-bridges, capstans, &c., but latterly this class of machinery has been much improved and its applications extended. Nowadays hydraulic pressure is used instead of the steam-hammer for forging wrought iron; it has also been used with marked success for riveting, and for the working of heavy guns, including the controlling of the recoil. Hydraulic machinery for the loading and discharging of merchant steamers has now been brought to great perfection, and is in many cases preferable to the use of the steam engine. Its uses for the working of lifts are too well known to need more detailed reference. **Hydraulic Machinery.**

The Elements of Machines are represented under Group XII. There are, however, very few exhibitors under this heading. **Elements of Machines**

Group XIII. will probably hereafter be regarded as the most remarkable feature of the Inventions Exhibition. Under it are classified the **Machines Electricity.**

For Contents, see p. 3; View of Gardens, p. 41; Ground Plan, between pp. 48 and 49; View of Old London, p. 56; Index, p. 67; Method of reaching Exhibition, pp. 72-77.

innumerable inventions in electric science which, for the most part, belong to the last ten years. In the year 1862 electricity had but few practical uses, if we except those of telegraphy and metallic plating, but to-day it has penetrated into nearly every branch of practical engineering. The following list gives a few of the more important inventions in this branch of science :—

The continuous-current dynamo or self-exciting electro-magnetic generator, for transforming energy, as supplied to it by the steam engine, water-wheel, &c., was simultaneously developed by Wheatstone, Varley, and Werner Siemens.

**Electric
Motors.**

The discovery that by reversing a dynamo, by sending a current of electricity through it, it could be used as a motor, that, in fact, the combination of a source of electricity with such a reversed dynamo constituted a prime mover in exactly the same sense as the combination of a steam generator and engine, will probably be in the future regarded as one of the most important of the characteristic inventions of this Exhibition. This discovery has led the way to the solution of the problem of the transmission of electric energy to great distances. As an example of what has already been accomplished in this direction, it may be mentioned that at the Munich Exhibition half a horse-power of energy was transmitted through a common iron telegraph wire for a distance of forty miles.

The discovery of the electric motor has also rendered it possible to drive boats, tramcars, and carriages by means of electricity, while recently several electrical railways have been constructed, the most remarkable being the Portrush Railway in the North of Ireland, in which the source of power employed to generate the current is a natural waterfall.

**Electric
Lighting.**

The application of electricity to artificial lighting is, however, the discovery in which the public at the present moment takes the greatest interest. The whole Exhibition, with its innumerable arc and incandescent lamps, is a remarkable proof of the perfection to which this system of lighting has been brought during the last few years.

**Galvanic
Batteries.**

Primary and secondary batteries have also undergone wonderful development during the period under review. The primary battery is still, as it has always been, the only means for generating powerful electric currents at first hand, and there are exhibited in this group specimens of primary batteries of a power which was formerly thought to be unattainable, and which are at the same time exceedingly easy to manipulate.

Secondary batteries are in reality primary batteries in which the waste chemical products are capable of regeneration *in situ* by the mere process of sending a current of electricity in the reverse direction through the cells. They are doubtless destined to play an important rôle in the future in all descriptions of electrical work.

**Electro-
metal-
lurgy.**

The progress made in Electro-metallurgy has not been less remarkable than that made in every other section of this group. The introduction of dynamos capable of delivering enormous currents of a low potential has rendered possible the deposition of masses of metal which could formerly not even be thought of. It is now possible to manufacture refined copper in the largest quantities direct by the electrical process,

while such operations as the coating of the plunger of a large hydraulic ram with a deposit of the toughest reguline copper half an inch thick, is a comparatively easy operation.

Turning from the purely engineering developments of electrical science, we find that in Telegraphy the principal improvements have been the duplexing and quadruplexing of single wires, by means of which, respectively two and four messages can be simultaneously transmitted over the same wire; but the most extraordinary advance in this department has been the invention of the Telephone, which enables sounds to be faithfully reproduced at great distances.

The great progress effected in every branch of electricity has, as a matter of course, rendered necessary a corresponding advance in the instruments used for testing and for indicating the quantity, potential and energy of currents.

Under Group XIV. are included apparatus, processes, and appliances connected with applied Chemistry and physics. At the present day chemistry plays a most important part in our national industry, in fact there are few branches of applied science, from metallurgy to calico-printing, in which a knowledge of chemistry is not more or less directly useful. Since 1862 our knowledge of theoretical chemistry has been greatly increased, but in its practical applications to the arts, the two greatest advances are the supersession of the celebrated Leblanc process for the manufacture of carbonate of soda by the so-called ammonia soda process—and the improved means of utilising the bye-products from gas works and coke ovens, by which we obtain the numerous coal-tar colours, ammonia, tar, pitch, benzene, &c.

Our knowledge of the effects of artificial manures has advanced considerably during the last few years, and many of the exhibits in Group XIV. illustrate this subject.

The exhibits relating to Gas and other illuminants are arranged under Group XV. These include improvements in the apparatus and methods of manufacture of coal gas. Also gasoline, gas-making machinery, photometers, governors, meters, and improved burners, including in the latter various forms of regenerative burners, in which the heat generated by the flame is used to raise the temperature of the air necessary to sustain combustion. The improvements in the manufacture of gas introduced since 1862 relate principally to the details of the apparatus employed, to the methods of purification, and to the utilisation of the waste products. The petroleum industry has been practically created since 1862, and this section of the Exhibition is naturally well supplied with specimens of lamps suitable for burning mineral oils.

Fuel and Furnaces form the subject matter of Group XVI. These, however, were amply illustrated both in the Health and the Smoke Abatement Exhibitions, and have in consequence been allotted but little space on the present occasion. Both gas and oil have lately been much used as fuels for domestic heating and cooking purposes. The greatest revolution, however, in fuel and furnaces since 1862 is the invention of the Siemens' regenerative gas furnace and gas producers, so largely used in the manufacture of steel. In these furnaces the raw coal is first distilled in gas-producers, and the common species of gas produced is used in the furnaces in lieu of raw coal: the air

necessary to maintain combustion is heated by the waste heat passing away from the furnace, an arrangement which enables an intense and easily regulated heat to be produced with a notable economy of fuel. This form of furnace is illustrated in the Exhibition.

Food. Group XVII. relates to Food, Cookery and Stimulants, Group XVIII. to Clothing, subjects which were exhaustively dealt with last year.

Jewelry. Group XIX. deals with Jewelry.

Leather. Leather is represented under Group XX. ; there are few noteworthy improvements to be chronicled in this branch of industry. The demand for cheap leathers for the soles of boots has, however, led to the adoption of a chemical process for tanning in place of the old-fashioned and very slow method of tanning by oak bark. The hides, in the new method, are immersed in a weak solution of bichromate of potash, common salt and alum ; and are afterwards finished by impregnation with paraffin, wax and resin. In this manner leathers can be tanned in about five weeks which formerly took at least eighteen months, but the saving in time is perhaps effected at the expense of quality.

India-Rubber and Gutta-Percha. Under Group XXI. are arranged various exhibits illustrating the India - Rubber and Gutta - Percha industries, together with sundry kindred manufactures, such as those of Celluloid and Vulcanised Fibre. The two latter are new articles which will be much used in the arts. The great majority of the processes connected with the india-rubber and gutta-percha manufacture were understood and practised before 1862.

Furniture and accessories. Group XXII. illustrates inventions relating to domestic furniture, travelling equipment, materials for wall and floor covering, &c. The furniture and decorations in the Royal Pavilion are included in this department.

Glass and Pottery. Glass and Pottery are classified under Group XXIII., which also includes examples of the more modern kilns and ovens used in the manufacture. The improvements to be recorded since 1862 are chiefly those of design, and the more extended application of pottery ware to decorative and sanitary purposes. In the latter department especially the improvements to be recorded are most important, but were amply illustrated in the Health Exhibition. The process of toughening glass by tempering it in oil is a new improvement which is probably destined to find extended application.

Cutlery and Ironmongery. Group XXIV. deals with improvements in Cutlery and Ironmongery, and includes Surgical Instruments.

Fire-arms and Military equipment. The important subjects of Fire-arms, Military Weapons and Equipment, and Explosives, are classified under Group XXV. If the improvements recorded in the industrial arts since the year 1862 are truly remarkable, it must be confessed that the progress attained in the destructive arts of warfare are not less impressive. The Exhibition held twenty-three years ago contained a few specimens of light Armstrong field-pieces and other guns, but at the present time the largest specimens of heavy ordnance attain the weight of 110 tons, and their projectiles alone weigh more than the cast-iron guns with which the naval battles of the last century were fought. The immensely increased size and power of the guns, projectiles and ammunition has rendered necessary a corresponding development in the means of mounting and working the guns, checking the recoil, and effecting the operation of

Heavy Guns.

loading. The introduction of steel as the material for the construction of ordnance, though possibly not unattended with a certain amount of risk, constitutes upon the whole a most important improvement. The earlier Armstrong guns were breech-loaders, but for many of the years intervening between 1862 and the present time breech-loading was abandoned in this country. The invention in France and Germany of two successful methods of opening and closing the breeches of even the heaviest guns has, however, rendered a return to the breech-loading system very general. Great improvements have been made in the projectiles and the methods of rifling, as also in the manufacture of the gunpowder. Instead of the violently explosive, quick-burning powders which were common a quarter of a century ago, slow-burning powders, which generate a more moderate and more sustained pressure, are now in common use for heavy guns. Further important improvements in this direction may be expected. The results of the improvements in the proportions of the guns and in the quality of the powder are such that muzzle velocities of about 2000 feet a second, are now common for the projectiles of heavy guns.

The improvements effected in Small-Arms are not less remarkable. Small-Arms. Breech-loading is now universal both for military and sporting weapons, and the range, trajectory and accuracy of all description of rifles has greatly increased. In shot-guns, for sporting purposes, the introduction of choke-boring has enabled increased ranges to be attained, and permits within certain limits of any desired closeness of "pattern." Amongst the latest novelties are the introduction of hammerless guns and nearly smokeless powders. A perfectly new departure in weapons of offence was the machine gun, the first type of which was used by the French in the Franco-German War. The power of this class of weapon has been latterly much developed.

Amongst the most deadly of the modern implements of war is the Torpedoes. torpedo, the original form of which was used in the American War of Secession. The highest development of the modern torpedo is the Whitehead, which is furnished with a set of engines and a screw-propeller, and can be made to travel for a limited distance at very high speed, either on the surface or at any assigned depth below the water.

To Group XXVI. belong the important subjects of Paper, Printing, Paper and Printing. Stationery, &c. Few people have any idea of the gigantic consumption of paper in this country, or of the serious paper famine with which we were threatened before an efficient substitute was found for rags, as the raw material of paper manufacture. The discovery of that substitute in the shape of ground wood is one of the important inventions which has been developed since 1862. A superior form of wood paper is obtained by disintegrating the wood by chemical means instead of by grinding.

In printing, the most remarkable improvement has been the invention of the type of machine represented by the "Walter" press for printing newspapers. By means of this machine a reel of paper four miles in length is printed continuously on both sides. It is fed between two pairs of cylinders arranged vertically over each other. The surface of the topmost cylinder is a stereotype cast of the matter to be printed on one side of the paper, while similarly the surface of the lowermost prints the remaining side.

A notice of the improvements made in this group would be very incomplete without a reference to the great progress made in the art of printing plates and blocks prepared from photographs.

Clocks and
Watches

Group XXVII. includes Clocks, Watches, and other time-keepers. There is no striking novelty, except the extended application of machinery

Philoso-
phical
Instru-
ments.

in the manufacture of the parts of watches, to record in this department. Philosophical Instruments and apparatus are classed under Group XXVIII. The immense advances made in our knowledge of physical sciences has led to a corresponding advance in the instruments of precision by which natural phenomena are observed and recorded. It would be obviously impossible in these pages to call attention to even one-tenth of the remarkable instruments which have been either invented or improved during the last quarter of a century: amongst them we may however quote the important mechanical integrators brought out by Amsler in Switzerland,—the mercurial air pump, which is the most powerful known means of producing a vacuum, without the aid of which incandescent electric lighting would be impracticable,—and lastly the spectroscope, which is probably the most powerful instrument of analysis which has ever come into the hands of the chemist.

Photo-
graphy.

Photography is the subject matter of Group XXIX., and in this branch of practical science enormous improvements have been made during the last few years which are admirably illustrated in the Exhibition. These improvements extend alike to the negative and printing processes, as well as to the apparatus made use of by the photographer. In producing the negative the substitution for the old wet plate process of gelatine plates has worked wonders in simplifying photography, and in bringing its successful practice within the reach of amateurs. In the printing processes the discovery of the properties of bichromated gelatine has prepared the way for the introduction of numerous methods for multiplying prints from photographs.

Educa-
tional
Apparatus.

Group XXX. represents Educational Apparatus, a subject which was amply illustrated last year.

Toys.

Group XXXI., which is the last section of Division I., illustrates improvements in Toys, Games, &c.

Music.

Division II. deals exclusively with Music, and is divided into three groups, of which the first relates to musical instruments and appliances constructed since 1800; the second to music engraving and printing; and the third comprises the Loan Collection of old instruments, pictures, scores, &c.

Musical
Instru-
ments.

Musical Instruments and appliances are classified under Group XXXII. Since the year 1800 the improvements imported into instruments have been innumerable. The full orchestra, such as we know it, is practically the same as it was at the end of the last century, but of the instruments comprising it the string group alone remains unchanged. The Flute was perhaps the first to undergo reformation, and in the hands of Boehm became what we now know it. He altered the bore, the position and shape of the holes, the venting of the holes, the action of the keys, and the fingering. Other inventors have endeavoured to apply the inventions of Boehm with partial success to the double and single Reed

Flutes and
Reed In-
struments.

Instruments, viz. oboe and bassoon, the clarinet, basset-horn, and bass clarinet. In Brass Instruments the principal changes have been the introduction of keyed instruments, such as the Kent bugle and ophicleide as substitutes for the older type of sliding brass instruments represented by the trumpet and trombone. Keys have, however, been superseded by the invention of piston valves, which are now applied to cornets, horns, euphoniums, and bombardons. **Brass Instruments**

The greatest musical invention of the present century is the pianoforte, which has been developed by a series of improvements out of the old harpsichord. By the introduction of tension bars, metal frames, and other improvements, it was found possible to endow this instrument with a power which was formerly thought unattainable. Some idea of the strains put upon the frames of modern grand pianofortes may be gained from the fact that the total tension in the strings of some of these instruments attains the figure of about 25 tons. The Exhibition is very rich in its collection of pianofortes, which illustrate all the recent improvements in frames, sound boards, and actions. The organ also has undergone many mechanical improvements in the present century, the principal of which are the pneumatic and electric methods of lightening touch,—the methods of regulating the pressure of wind,—the application of mechanical instead of hand power for actuating the blowing apparatus,—and the introduction of the pneumatic tubular transmission which enables the player to be seated at a considerable distance from his instrument. The harmonium and the American organ are instruments of comparatively recent introduction.

Group XXXIII. represents Music Engraving and Printing, and Group XXXIV., which completes the list of subdivisions of the Exhibition, contains a very interesting Collection of Antique Instruments, Pictures and Old Musical Scores, which will doubtless attract very considerable attention. The foregoing relates to the more serious side of the Exhibition, which is perhaps more amply developed than in either the Fisheries or the Health Exhibitions. Amusements and recreation have, however, not by any means been neglected. Old London, which was such a popular feature last year, still remains, the houses being fitted up as shops, in order to illustrate as far as possible the contrast between the ancient and modern industries. **Loan Collection**

The Gardens will this year be more beautiful than ever, being illuminated throughout by electricity, and great care has been bestowed on the musical arrangements, all of which will be described at length in their proper place. **Gardens and Bands.**

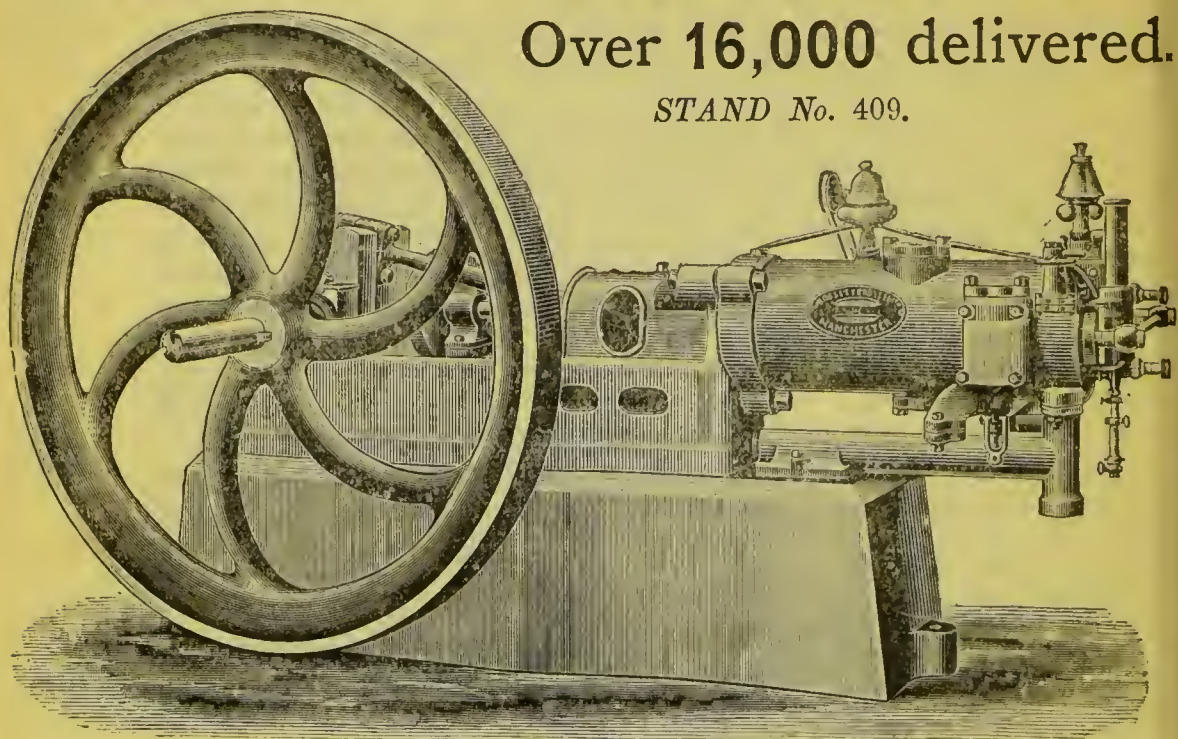
The very onerous task of organising this exceedingly technical Exhibition has been carried out by an Executive Committee appointed by H.R.H. The Prince of Wales, of which the Chairman is Sir Frederick Bramwell, and the other Members are gentlemen well qualified by their position, their industrial knowledge, and their experience in organising Great International Exhibitions, to carry out the task successfully. **Executive Council.**

The Visitor who has familiarised himself, by reading the foregoing sketch, with the scope and general organisation of this Exhibition, will find it all the easier to examine and understand its contents.

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OFFICIAL GUIDE

TO THE

INTERNATIONAL INVENTIONS EXHIBITION.

I.—GENERAL DESCRIPTION OF BUILDINGS AND ARRANGEMENT OF GROUPS AND FOREIGN COUNTRIES.— BEST METHOD OF SEEING THE EXHIBITION.

BIRD'S-EYE VIEW OF BUILDINGS—COLOURED GROUND PLAN—ALTERA-
TIONS IN BUILDINGS—ARRANGEMENT OF GROUPS AND FOREIGN
COUNTRIES—DINING AND REFRESHMENT ROOMS—BEST WAY OF
VISITING THE EXHIBITION.

THE visitor who proposes to see the Exhibition will do well before going on his rounds to acquire a general knowledge of the situation of the principal buildings, and of the arrangement of the principal groups of subjects and foreign countries. This is the more necessary because all the principal galleries, courts and arcades are designated with reference to the points of the compass. The northern end of the buildings is adjacent to the Albert Hall and great Conservatory. The south faces the new Natural History Museum. Prince's Gate, or Exhibition Road, forms the eastern, and Queen's Gate the western boundary of the Exhibition. The principal entrance by which the majority of railway passengers obtain access to the buildings is on the eastern side, and there is also an entrance from Queen's Gate. This explanation will enable the visitor at once to understand the whereabouts of such buildings as the Southern Gallery, Western Quadrant, Eastern Arcade, &c.

**Bird's-eye
view of
Buildings.**

The reader will observe that the coloured Ground Plan between pages 48 and 49 is marked all over with numbers which relate to the Groups, the references to which are to be found in the margin of the Ground Plan.

**Coloured
Ground
Plan.**

The general arrangement of the buildings is the same as that adopted last year; but as a great deal of additional space was required, it was found necessary to take down the labyrinth of small courts on the north side of the Southern Gallery, and also to remove the Dining Rooms on the south side. The spaces thus liberated have been roofed over as continuous courts and thrown into the Southern Gallery, while the Dining Rooms occupy the space on which the Dairies formerly stood. The Eastern and Western Galleries have also been made continuous with the East Arcade and West Annexe respectively, and in this way the buildings have been simplified and considerable space has been gained. The buildings of the Central Institution of the City

**Alter-
ations in
Buildings.**

and Guilds of London Institute are not this year included in the Exhibition.

Arrange-
ment of
Groups.

Foreign
Countries.

As was the case last year, the great bulk of the Exhibition being of British origin, the general arrangement of the Exhibition is not one of countries, but of groups of subjects. The Foreign Countries are, however, kept by themselves, their exhibits not being mixed up in the general groups. America and Russia occupy the West Central Gallery, while Germany, Siam, and Japan are lodged in the East Central. China still holds its old position in the East Gallery, and Austria is lodged in the old Water Companies Pavilion.

The Great South Gallery is now divided lengthwise into North, Middle, and South Courts. The North Court is given up to Engineering Construction, Mining and Metallurgy, and Elements of Machines, together with part of the display of Military Weapons and Railway Plant. The Middle Court contains the principal portion of the two last-mentioned groups, and also the important collection of Prime Movers. The South Court is given up to Agriculture and Horticulture, while farther on are the Dining Rooms of the School of Cookery and of Messrs. Spiers and Pond.

The machinery for electric lighting is in its old position between the South Gallery and the Old London Street. Naval architecture and carriages and bicycles are lodged in the Queen's Gate Annexe, occupied last year by Belgium. The Aquarium being a permanent institution maintains its former position. Machine tools fill one half of the West Gallery, and hydraulic machinery the West Annexe, while the other half of the West Gallery and the West Arcade are given up to textile fabrics. The East and West Quadrants which connect the two sides of the Exhibition together, and skirt the Gardens, are occupied in the following order by the groups representing Cutlery and Ironmongery—Pottery and Glass—India-rubber—Leather—Clothing—and Toys. The Eastern Arcade contains the exhibits relating to Fuel, Gas and other Illuminants, and Electricity. The East Gallery contains China, part of the Musical division, and the section relating to Paper and Printing. The East Annexe is a detached building, given up wholly to Food, Cookery, and Stimulants. The whole of the Central Gallery is taken up with Music, and there is also a large Music Room for the trial of instruments, &c., in the East Central Gallery. The remainder of the latter building belongs to Germany, Siam, and Japan, and the corresponding West Central Gallery contains the American and Russian divisions. The South Central Gallery going from east to west contains in successive order the groups relating to Chemistry, Philosophical Instruments, Jewelry, Watches and Clocks, Photography and Furniture. The Old London Street is of course in its old position to the south of the Central Galleries on the west side of the Central Avenue, while the Prince of Wales' Pavilion is in a corresponding position on the east side. Austria and Hungary occupy the Pavilion erected last year for the Water Companies to the east of the Prince of Wales' Pavilion.

Dining
and Re-
freshment
Rooms.

The Dining and Refreshment Rooms are distributed all over the buildings, and are referred to more particularly hereafter. The general refreshment contractors are on this occasion Messrs. Spiers and Pond, who have made ample provision for the accommodation of large num-

Best way
of visiting
the Build-
ings.

bers of visitors at different rates of prices. The National Training School of Cookery, whose cheap dinners and teas have been so highly appreciated during the last two years, occupy their old quarters in the South Gallery, and there are numerous tea and cocoa houses in the gardens and scattered about the buildings. The visitor who has mastered the above general information will, with the aid of the Ground Plan, have no difficulty in finding his way to any particular section of the Exhibition which he may wish to study. The general sightseer will however probably prefer to go systematically through the various groups and buildings, and in conducting him through them we propose to follow the plan which was last year found to be simple and successful, viz., to commence at the main entrances in the Exhibition Road, and proceed through the three courts of the Southern Gallery to the extreme western end, then turn to the right and visit all the circumferential buildings with their annexes until the starting-point is once more reached. The Central Galleries, together with the Old London Street and the Prince of Wales' and the Austrian Pavilions, will be taken next, and the detached buildings and gardens last.

II.—THE ENTRANCES AND SOUTH GALLERY WITH ITS COURTS.

ENTRANCES—SUBWAY—VESTIBULE—DUVAL DINING ROOMS—MILITARY AND SPORTING WEAPONS—AGRICULTURAL MACHINERY—ENGINEERING CONSTRUCTION AND ARCHITECTURE—MINING AND METALLURGY—RAILWAY PLANT—PRIME MOVERS—NATIONAL TRAINING SCHOOL FOR COOKERY—MESSRS. SPIERS AND POND'S DINING ROOMS AND BUFFETS.

The principal entrance to the Exhibition by which the great majority of visitors are sure to pass the turnstiles, is situated in the Exhibition Road, about a quarter of a mile from the South Kensington Station of the Metropolitan and District Railways.* A spacious Subway lined with white glazed bricks connects the Railway Station with the Entrance to the buildings, and this will doubtless be found a great convenience by passengers, and will tend to relieve the excess of traffic in Exhibition Road. Principal Entrance.

On passing the turnstiles the visitor enters the Vestibule which, together with the old Council Chamber of the Royal Horticultural Society beyond it, is kept free from exhibits which would tend to produce a congestion of traffic. The Vestibule contains a fine equestrian statue of the Prince of Wales, the original being by Mr. Boehm, R.A., Vestibule.

* For Railway Map, and short account of Railway and Omnibus facilities to the Exhibition, Cab fares, &c., see pages 72-77.

For Contents, see p. 3; View of Gardens, p. 41; Ground Plan, between pp. 48 and 49; View of Old London, p. 56; Index, p. 67; Method of reaching Exhibition, pp. 72-77.

and presented by Sir Albert Sassoon to the Municipality of Bombay. The side walls have been redecorated with cartoons illustrating the historical development of some of the principal inventions represented in the Exhibition, an ancient and a modern subject having been selected for each of the principal groups.

In the department of Mining and Metallurgy we have a representation of ore-dressing as reproduced from an old work of the sixteenth century, contrasted with the modern system of hydraulic mining as practised in California. Also the Catalan process for producing forged iron, introduced in the thirteenth century, side by side with the Bessemer process for producing steel.

Engineering Construction is represented by girder bridges of the sixteenth century faithfully reproduced from designs by Leonardo da Vinci, and the East River Bridge in New York. Improvements in locomotion are illustrated by George Stephenson's "Rocket," side by side with a modern express passenger engine.

Naval Architecture is represented by Miller & Symington's original steamboat, with interior paddles, contrasted with the "America," one of the latest Transatlantic Liners now being converted into a fast cruiser.

To illustrate Textile Machinery, an early loom of the sixteenth century and a modern machine loom have been chosen.

Otto von Guericke's electrical machine of the seventeenth century and a Gramme continuous-current dynamo exemplify the progress made in electrical science.

The contrast between ancient and modern ordnance is well brought out by a picture of a Venetian cannon foundry of the sixteenth century and a modern Woolwich breech-loader.

Probably no contrast is more marked than that between an early printing press and the Walter Press, as used for printing the *Times* newspaper.

To illustrate Clock-making there is a picture of an ancient clock-maker side by side with a representation of part of Messrs. Rotheram's watch factory at Coventry.

Messrs.
William
Clowes &
Sons, Limited.

The Entrance Hall contains also two of the stalls of Messrs. William Clowes & Sons, Limited, the official printers to the Exhibition. At these stalls the official literature, viz. the Catalogue, the Guide, and the Daily Programme, may be purchased. The same firm have other stalls at the Exhibition entrance to the subway, and at all the principal entrances. The Daily Programme is printed at the Exhibition in an iron house in the grounds, just outside the North Court of the South Gallery.

Duval
Dining
Room.

On the right-hand side of the Vestibule is the Jury Room, and beyond that again the Duval Dining Room of Messrs. Spiers & Pond, for the service of cheap dinners *à la carte*. The object of the management is to serve a well-cooked and varied repast at an extremely moderate price. There is also here a fixed-price dinner from the joint at one shilling per head, served from 12 till 4, and an abundant tea from 4 till the closing of the Exhibition, at the same price. The distinguishing feature of the Duval System is, that each diner is provided with a bill of fare on which the prices are marked, and each dish as ordered is entered on the account which is left on the table during the repast, open to

the inspection of the guest, who can thus know exactly what he has spent, and can compare the prices as charged with the figures on the bill of fare.

On passing through the entrance halls the visitor finds himself at the head of a flight of broad steps which lead down to the South Gallery. This part of the Exhibition is now an imposing structure, having been trebled in width since last year, and divided lengthwise into North, Middle, and South Courts.

Immediately at the foot of the steps in the Middle Court, and occupying also a small portion of the North Court, is a fine collection of Military and Sporting Weapons classed under Group XXV. (see also page 12). The most prominent object which attracts the eye is a Woolwich breech-loading 8-inch gun, built entirely of steel. It consists of an inner core or barrel upon which are shrunk a breech piece and front hoop. Upon these are shrunk the trunnion ring and a tier of breech hoops. The breech is closed by means of a screwed plug, the screw thread being interrupted in four divisions. The breech is rendered gas-tight by means of an asbestos wad, tin discs, and steel-bearing rings. This gun weighs 12 tons, it fires a charge of 105 lbs. of Cocoa powder. The projectile weighs 210 lbs. The velocity of the projectile at the muzzle is 1970 ft., and at 1000 yards 1805 ft. per second. At 1000 yards it can penetrate 14 inches of armour. The gun is rifled with 32 grooves, having a gaining twist for half the length of the rifled portion and being uniform for the remaining half.

The Royal Arsenal also shows a new type of steel breech-loading field piece weighing 7 cwt. The muzzle velocity with a projectile weighing 125 lbs. and 4 lbs. of powder is 1705 ft. per second.

An interesting tool shown by the same department is the 20-inch Trepanning Bar for boring large guns. Instead of effecting the operation of boring by removing the metal in shavings, it actually cuts a solid cylindrical core out of the gun. This steel core can of course be afterwards used for various purposes, whereas if the boring had been effected by the old process the shavings would only have had the value of scrap. Solid cores as long as 32 feet have been removed by this process.

The Royal Arsenal shows also accessories, such as tangent sights, percussion locks, turret sights, and a model breech of the 9.2 inch gun complete.

The Royal Laboratory exhibits, as a contrast, the ammunition and projectiles of a 68-pounder smooth-bore gun, which was the standard heavy naval gun in 1862, side by side with a 12-inch breech-loading cartridge complete, together with 12-inch common and Shrapnel shell. The same department shows also various other samples of ammunition, fuses, &c.

The Royal Small Arms Factory at Enfield contributes four Nordenfeldt machine guns of various sizes, together with Snider and Martini-Henry rifles and carbines; also a collection of swords, lances, pikes, &c.

The Royal Engineers' Establishment at Chatham have a collection illustrating Submarine Mining; also models of pontoons, bridges, &c.; a complete balloon equipment and photographic, electric, and signalling apparatus.

**Royal
Gun-
powder
Factory.**

The Royal Gunpowder Factory at Waltham Abbey contribute a case showing by models the successive stages of the progress made in the manufacture of the various kinds of service gunpowders since 1862, and specimens illustrating the manufacture of compressed gun-cotton (Abel's system) for Submarine mining and for Engineer field and siege purposes; also models of the largest cartridges in use in 1862 and 1885, and electric lamps, with water jackets, as used for the illumination of powder factories.

**Breech-
loading
Guns,
Rifles, &c.**

In addition to the above collection of military weapons and appliances, there are numerous cases of sportsmen's fire-arms and ammunition, exhibited by many of the best known makers (see also p. 13). The inventions which they illustrate for the most part have reference to improvements in the actions and barrels. Breech-loading is now of course universal. Hammerless guns are fast superseding the old-fashioned sort with exterior hammers, and there are many devices shown for increasing the safety and convenience of this new type of weapon. One of the latest improvements shown is Joseph Needham's cartridge ejector, by means of which either or both cartridges are ejected from the gun automatically when the breech is opened, thus insuring great rapidity in loading. Mr. Needham's stand is detached somewhat from the majority of exhibitors of sporting firearms, being situated in the North Court of the South Gallery, close to the doorway leading to the grounds. It will be found interesting by sportsmen, for in addition to the ejecting hammerless gun there is also a very simple magazine rifle, and the first breech-loading hammerless gun ever made, and which was invented by Joseph Needham, and exhibited so far back as the Exhibition of 1851. Opposite Mr. Needham's stand Lieut-Col. Malet exhibits a life-sized model of a Hussar, furnished with an improved cavalry equipment, which enables the trooper to do dismounted work without retaining his sword. The picture at the back of the model illustrates an occasion on which the value of the new equipment would be demonstrated.

**Joseph
Needham's
Ejector
Guns.****Lancaster's Four-
barrel
Guns.**

Mr. Charles Lancaster exhibits an interesting novelty in the Centre Court—viz. Spencer's patent repeating single-barrel shot gun, which can be fired six times without reloading, and also a four-barrel 20 bore hammerless fowling-piece, weighing only $7\frac{1}{2}$ lbs.

Steel, which has been making so much headway lately amongst engineers, is beginning to be patronised by some gun-makers as a substitute for the old and trustworthy iron damascus barrels, and really beautifully-made solid drawn-steel barrels are now obtainable. They are undoubtedly more durable than iron barrels, and if proper precautions are observed in the process of brazing, these steel tubes will, probably, eventually earn the confidence of sportsmen. Several samples of steel barrels in the rough and finished are shown by various manufacturers and gun-makers.

Amongst the other inventions in fire-arms which have been made since 1862 we may mention choke-boring, and the express system for rifles. Cartridges have also been greatly improved; those made of solid brass are favourably spoken of by some gun-makers. Amongst the most remarkable departures from long-established custom is the attempt now being made to substitute explosives made of the nitro-compounds for the old-fashioned black powder, which has maintained its supremacy

for so many centuries. The new explosives have the advantage of being comparatively smokeless and noiseless, and give very little recoil. If, as seems now to be probable, they can be made perfectly uniform in their action, they will doubtless become very popular with sportsmen. All these improvements and innovations will be found to be well represented by different manufacturers.

The Lords Commissioners of the Admiralty have a large collection, illustrating the Naval Torpedo Service, containing amongst other things a Whitehead torpedo,—gun tubes and detonators,—naval mine cases,—firing batteries and other electrical apparatus. Torpedo Service.

Before leaving this portion of the Exhibition, the visitor who is interested in the appliances for war should inspect the model of Colonel Moncrieff's Hydro-pneumatic System of Working Heavy Guns. This model is exhibited by Messrs. Easton & Anderson, and is placed on the North side of the exhibits of the Royal Arsenal. Moncrieff's Hydro-pneumatic Gun-carriage.

The well-known firm of Sir W. G. Armstrong & Co. exhibit various rifled-guns and machine-guns. Included amongst the former is a short-rifled howitzer, and a screw-gun which takes to pieces for convenience of transport. The firm also exhibit harness and other appliances for the transport of mountain-mule batteries. Armstrong Guns.

The well-known machine-gun makers are well represented in this part of the building. Messrs. Nordenfeldt show several examples of their type of gun on the north side of the centre row, and Messrs. Hotchkiss and Mr. Maxim on the south side. Mr. Maxim's gun is the latest novelty in this class of weapon, and will well repay careful examination. Its distinguishing feature is that all the operations—reloading, firing, ejecting the empty cartridge cases, &c.—are automatically carried out by the gun itself, through the agency of the recoil generated by the explosion of each cartridge. Machine Guns.

In the South Court, immediately alongside the collection described above, is the Exhibition of Machinery and Appliances connected with Agriculture and Horticulture (see also page 6). In consequence of the numerous Exhibitions held by the Royal Agricultural Society, it was deemed unnecessary to allot as much space to this Group as its importance would otherwise have warranted. Nevertheless, most of the principal makers of Agricultural Machinery are represented, and a very interesting collection is the result. Agricultural Machinery.

Immediately at the foot of the steps on the South side of the Court, Messrs. Aveling & Porter exhibit a large road locomotive, one of the peculiarities of which lies in the spring wheels, which possess the advantage of causing the whole weight of the engine to be spring carried. The driving-wheels are fitted with compensating motion for turning sharp curves.

Continuing down the South side of the Court, we next come to the stand of Messrs. R. Hornsby & Sons, who exhibit their Sheaf-binder Harvester, which won the first £100 prize of the Royal Agricultural Society. The firm exhibits also various other agricultural machines.

Mr. Thomas Corbett has a very varied collection, including ploughs, harrows, a combined winnower, corn elevator, and weighing machine,—a grain, tea and coffee dressing machine with elevator attached,—cheese presses, &c. Close by, the McCormick Harvesting Machine Company

of Chicago exhibit an American-made sheaf-binding reaper. Mr. McCormick is stated to have been the original inventor of this most useful class of labour-saving machinery. Next in order come Messrs. H. Bamford & Sons' haymaking machinery, and Messrs. Richard Garrett & Sons' exhibits, the most important of which is a semi-portable compound engine, and a fire-box with corrugated crown.

Dairy-farming is represented this year by the Aylesbury Dairy Company, Limited, and the Dairy Supply Association, who exhibit amongst other apparatus the Danish Cream Separator, with the principle of action of which the public was familiarised during last year's Exhibition. There are several exhibits relating to the important subject of silos at this end of the Court, and in the centre is a large movable silo exhibited by Messrs. F. W. Reynolds & Co., fitted with his system of mechanical pressure. In front of this Messrs. Wills & Segar exhibit a beautiful rockery, with Wills' patent illuminated water-wheel and revolving-light machinery for lighting grottos, ferneries, &c.

Electro-
pneumatic
Organs.

At the west end of this Court is a fine electro-pneumatic organ, by Bryceson Bros., which is played from a distance of 40 feet.

Returning by the north side of the Court we first pass several exhibits relating to horticultural subjects, and soon re-enter the space allotted to Agricultural Machinery. One of the most important stands on this side is Messrs. J. & F. Howards', who exhibit a Sheaf-binder, adapted to cut and bind into sheaves all kinds of grain crops; it is fitted with a sheaf collector, by means of which the sheaves may be laid in rows for being set up in shocks. Next door Messrs. Ransomes, Sims & Jeffries exhibit their patent furnace and apparatus for burning straw, cotton, and maize stalks, and other vegetable substances, as well as coal and wood, adapted to portable engines, a most useful contrivance in countries where fuel is scarce. Another self-binding reaping-machine, together with other implements, is shown by the Johnstone Harvester Company, as also by Messrs. Walter Wood, and Messrs. B. Samuelson & Co. The latter firm exhibits also a Meadow Grass Mower, and a Self-Raking Reaping Machine, with side delivery. Messrs. Riches & Watts show a Revolving Rake, and a Grist Mill.

Engineer-
ing Con-
struction
and Archi-
tecture.

The visitor will now have returned to the steps leading down from the entrance halls, and can next cross over to the North Court of the South Gallery to the space allotted to Engineering Construction and Architecture. The great majority of the exhibitors in this section show such objects as improved materials for construction, *e.g.* patent stones, concretes, bricks, tiles, &c.,—improved systems of drainage,—doors, windows, and other fittings for houses,—improved floorings, roofings, and internal decorations,—also machinery for producing the above. There are also exhibited inventions relating to the permanent way of rail and tram ways. There are in addition a few important exhibits of the higher class of engineering works. The South Eastern Railway Company and Submarine Continental Railway Company have a very interesting collection of models relating to the Channel Tunnel, including a model of the bed of the sea in the Straits of Dover, showing the course of the proposed tunnel, and the geological formation along its centre line,—a model of the bed of the sea, showing the chalk formation at right angles to the line of the tunnel,—models of Messrs.

Channel
Tunnel.

Beaumont & Co.'s Boring Machines, used in the excavation of the tunnel, and various geological and other maps.

Mr. Banister, of the London and Brighton Railway, shows models of the new harbour at Newhaven and its breakwater, also a steam hopper barge for sinking bags of concrete weighing 100 tons, and one of Carey & Latham's concrete mixing machines.

Newhaven Harbour.

Messrs. Clark and Standfield have a large collection of drawings of hydraulic lifts,—accumulators,—rams and presses,—a railway lift,—floating docks,—hydraulic grid docks,—patent slip,—gripping camels for wreck raising,—and a method of constructing harbours, piers, and breakwaters.

Clark and Standfield's Hydraulic Machinery and Floating Docks.

Mr. George B. Rennie exhibits his navigable and self-propelling and careening floating dock, the purport of which is sufficiently described by its name.

Messrs. Amos & Smith, of the Albert Dock Works, Hull, show a working model of an excavator, for use in the construction of docks and railways, and for submarine dredging; also a working head of the machine in full size.

Messrs. Thwaite & Healey show the application of their system of removing sandbanks and other submarine obstacles to traffic or flow of water, for the removal of the Pluckington Bank under the St. George's landing stage at Liverpool.

The greater portion of the remainder of the North Court is taken up with the subjects of Mining and Metallurgy (see also page 6). The first stand which the visitor will pass is occupied by the Manganese Bronze Company, who show several specimens of their very useful alloy, including a large screw propeller, one of the blades of which has been badly bent, but not broken, by hitting against an obstruction. The Delta Metal Company and the Phosphor Bronze Company are also exhibitors of alloys, the latter Company showing also silicium bronze wire, suitable for telegraphic and electric-lighting purposes. The celebrated Rio Tinto Company exhibit a model of the open cast on the South Lode of the Rio Tinto mines in Spain. At the next stand on the South side are several safety appliances for mining, including a safety cage to suspend in the shaft in case the rope breaks; also an apparatus for preventing accidents from over-winding. These are exhibited by Mr. Stephen Humble. On the next stand Messrs. Robey & Co. show one of their compact 12-HP. Winding Engines, with locomotive boiler on a wrought-iron tank foundation, a useful arrangement, especially where materials for foundations are difficult to obtain.

Mining and Metallurgy.

On the south side is a small stand of historical interest, being a collection of original test samples of Bessemer iron and steel, exhibited by Sir Henry Bessemer.

Bessemer Steel.

On the north side of the Court, against the wall, Mr. Snelus, of the well-known Steel Works at Workington, exhibits improvements in the manufacture of steel. Amongst other things he illustrates the basic process of dephosphorisation, the invention of Messrs. Thomas & Gilchrist, which enables many of the poorer classes of ore to be used for steel-making which could formerly not be utilised on account of the phosphorus which they contained. The inventors, Messrs. Thomas & Gilchrist, are also themselves exhibitors of their process. Mr. Snelus

Basic process of making Steel from phosphoric pig.

**Gold and
Silver
Amalgamators.**

exhibits also apparatus for carrying hot steel ingots, and improved linings for Gjers' soaking pits. Nearly opposite, in the central row, the North-Eastern Steel Co. exhibit samples of their products. On a stand adjoining, on the south side of the central row, Messrs. Hayward Tyler & Co. have a large collection of direct-acting steam pumps for mining and general purposes. The large machine adjoining, on the same side of the centre row, is a 50-ton testing machine with autographic indicator attached, for ascertaining the strength of metals. It is exhibited by Messrs. Joshua Buckton & Co. Close by, Mr. F. G. Cranston exhibits several rock drills for driving tunnels, sinking shafts, &c., and also a coal-cutting machine. On the north side of the centre row the metallurgy of gold is illustrated by the Electro-Amalgamator Co., Mr. H. Cassel, and the Pyrites Smelting Co. The former company show their improved method of extracting gold and silver from the ores by the combined action of mercury and electricity. Mr. Cassel's method is devised to extract gold from refractory ores, which are often of no value though sometimes very rich in the precious metal, by means of electrolysis. Dr. J. R. Atcherley also shows a continuous mercurial rain amalgamator for saving float and flour gold, which would otherwise, on account of its lightness, be lost.

**Mining
Machinery**

Continuing towards the west end of the Court we find Messrs. Ernest Scott & Co. exhibit an electro-magnetic apparatus for extracting iron from other substances. A special feature in this apparatus is the automatic manner in which the iron is released from the magnets. The adjoining space on the north side is occupied by Mr. C. E. Hall with stone-breakers, pulverisers, and drawings of coal-washing and drying machinery. Mr. Charles Shepherd also exhibits coal-washing machinery and a dead-weight crushing mill. The well-known firm of B. & S. Massey, on the north side, have several steam hammers and a saw for metal cutting. In the adjacent space, on the same side, Messrs. Morris & Wood exhibit a large mill for grinding quartz, superphosphates, and other hard substances. Next to them, on the south side, Messrs. Hathorn & Co. show several of their rock drills, air compressors, hydraulic tunnel cars, and a steam engine. Messrs. W. H. Baxter & Co. exhibit improvements in stone-breakers and ore crushers, whereby an irregular movement is given to the jaw, which breaks the rocks with less power and produces better road-metal with less waste, and when set for fine crushing the irregular motion prevents the material from sticking in the jaw. Next door, on the north side, Mr. Crossley has an air propeller for moving large columns of air at low pressure, for ventilating mines, tunnels, workshops, &c. On the south side the Aqueous Works and Diamond Rock-boring Co. exhibit improvements in rock-boring apparatus; and following on, Messrs. T. B. Jordan, Sons, & Commans have a large collection of mining machinery, consisting of rock-drills, air-compressors, pulverisers, mineral-dressing machinery, a foundry sand mixer, and a patent spring beam hammer.

Near the diamond drills and mining machinery will be found a practical and effective instrument for the survey of boreholes, which is equally reliable at 500 and 5000 feet, and can be used in the smallest and most crooked bore. The well-known errors of diamond and other drills are thus detected, measured, and turned to useful account, instead

of being allowed to mislead and cause expense. In one mine alone, of which Mr. McGeorge, the inventor, furnishes a large diagram, the cost of a borehole search was over £3600, £2700 of which could have been saved by prior use of the Clinograph. Errors amounting to 75 feet in Australia and 150 feet in Germany have been detected, and all bores measured have been found in serious error.

At the western end of the Court are numerous exhibitors of Miners' Safety Lamps, one of which is an electric lamp, and in another the source of light is luminous paint.

Miners'
Safety
Lamps.

There are numerous other exhibitors in this section of the Exhibition whom lack of space renders it impossible to notice in detail; but amongst them may be noticed the Fleuss Breathing Dress, and the compressed lime cartridge. The former apparatus enables the wearer to enter a mine full of choke damp, fire damp, or smoke or other noxious atmosphere with perfect impunity, for he is enabled to inhale his own breath over and over again, as each exhalation is filtered through caustic soda, which deprives the vitiated air of its carbon.

Fleuss'
Breathing
Dress.

The compressed lime cartridge is now beginning to be extensively used for wedging down coal, as a substitute for gunpowder. It thus diminishes the risks of explosion. It is not only a safe system, but is profitable as well. In the well-known Shipley Collieries in Derbyshire its use has resulted in increasing the output of marketable coal by 500 tons per acre.

The power for driving the machinery in motion in this court is derived from a large compound engine exhibited by Messrs. Galloway & Sons. The cylinders, which are superposed, have 14 and 24 inches diameter respectively, and a 36-inch stroke. It is capable of giving off 160 horse-power. The steam is supplied from four steel Galloway boilers of 7 feet diameter and 28 feet in length, suitable for working at 80-lbs. pressure per square inch. The same firm have also supplied the whole of the shafting and framework for carrying the same, and also the steam and exhaust piping throughout the whole building.

Galloway's
Engines
and
Boilers.

The visitor will now retrace his steps and enter the Middle Court of the South Gallery at the spot where Mr. Webb's large locomotive engine marks the commencement of the Railway Group (see also page 19).

Railway
Plant.

Immediately before the locomotive in question is the full size apparatus for working and interlocking railway points and signals at a station with a level crossing, with gearing for working crossing gates interlocked with the points and signals, exhibited by Messrs. McKenzie & Holland. The same firm exhibits the model of a railway junction, showing the working and interlocking of points and signals, with Fisher's improved facing point lock. Close by, on the north side of the Court, Mr. W. R. Sykes shows his combined electric interlocking and blocking system for railways.

The next space is occupied by Mr. F. Webb's celebrated compound express passenger locomotive, the "Marchioness of Stafford." Mr. Webb, who is the Mechanical Engineer in Chief of the London & North Western Railway, was the first in this country to apply the compound system to locomotives, and he has done so with so much success that his innovation must be accounted the most important improvement

Compound
Locomo-
tives.

in this class of engine which has been introduced for many years. The engine exhibited has three cylinders, instead of the two which had become traditional in locomotives. Of these, the two smaller or high-pressure cylinders drive one pair of wheels with outside cranks, and the third, or large low-pressure cylinder, drives a second pair of wheels with an ordinary bent crank axle. Joy's valve gear is used in this engine. Mr. Webb also exhibits improvements in radial axle boxes for locomotive and other rail vehicles, and in interlocking and working points and signals, and patent steel sleepers for permanent way.

**Tramway
Engines.**

In the adjoining space Messrs. Merryweather & Sons show a tramway locomotive fitted with air condenser, speed governor, and steam brake. It is said to be specially adapted for steep gradients, and to be free from noise and smoke. The Falcon Engine and Car Co. also show a steam tramway engine, and a working drawing of a condensing tram engine, patented by Mr. N. Scott Russell. Close by, Messrs. Black, Hawthorn & Co. exhibit another steam tramway motor. In consequence of the rapid spread of tramways throughout the country, and the great and growing expense of horse traffic, there is a much-felt want for an efficient tram engine. In consequence of the imperfection of the permanent way of tramway lines, it is an exceedingly difficult task to devise such an engine which shall be efficient and at the same time comply with the requirements of the Board of Trade.

**Railway
Brakes.**

The subject of mechanical brakes for railway trains is well illustrated, there being no less than eight exhibitors of improvements in this apparatus. The two best known and most important are the Westinghouse Brake Co. and the Vacuum Brake Co., which occupy stands close to each other, and following immediately after Mr. Merryweather's engine. The Westinghouse Co. exhibit their automatic air brake and passenger communication, and also direct acting pumps for air, water, or vacuum. The Vacuum Co. exhibit their vacuum continuous automatic brake, with universal couplings. The subject of brakes is a most important one for the travelling public, and the introduction of the continuous automatic brakes of the two above companies has probably contributed more than anything else during the last few years towards the diminution of the frequency of railway accidents. The remainder of the exhibits in this Group relate chiefly to improvements in the details of carriages and waggons, such, for instance, as couplings, drawbars, buffers, lamps, ventilators, windows, doors, &c.

**Prime
Movers.**

The whole of the remainder of the Middle Court as far as the western boundary of the Exhibition is taken up with the important subject of Prime Movers. (See also page 6.)

**Water
Motor.**

The first exhibitor whom the visitor will pass is Mr. A. S. Sealy, whose space lies immediately to the south of the Westinghouse Brake Co., and who exhibits a Water Motor constructed with endless chains and balanced feathering floats adapted to the utilisation of river and tidal force.

**Otto Gas
Engines.**

Messrs. Maudslay, Sons, & Field exhibit a model of the four-cylinder compound engines which they have fitted to the large vessels of the White Star Line and the Compagnie Générale Transatlantique.

The well-known firm of Crossley Bros. have a fine collection of the Otto Gas Engines manufactured by them; the largest of these is of

7 horse-power. These engines have of late years come into very extensive use, and they now play a most important part in our national industry, being invaluable as motors in all cases where boilers are impracticable or inconvenient.

Close to Messrs. Crossley, on the north side of the centre row, Messrs. Jeffery & Blackstone show a very compact and convenient form of vertical steam engine and boiler, mounted on two high wheels; and the Fairlie Engine and Rolling Stock Co. have some beautifully made models of Fairlie's double bogie locomotive for narrow-gauge mountain lines, and also improvements in iron and steel permanent way.

The next space is taken up by Messrs. Daniel Adamson & Co., with a large steam engine with the Wheelock automatic cut-off, designed to give regulation and economy of fuel, and also a 100-ton testing machine for obtaining tensile and other tests of metals. Following on, the Coalbrookdale Co., which contributed so largely to last year's Exhibition, come again to the front with a large collection, including a Parker & Weston's patent steam pump,—a Coalbrookdale engine,—one of Elwell & Parker's high-speed engines for electric lighting,—and lastly, some vertical pumps.

Daniel
Adamson.

Coalbrook-
dale Co.

In the next space Messrs. Greenwood & Batley show a high-speed horizontal engine, with Armington & Sims' cut-off. Messrs. J. & E. Wood show a fine Corliss engine, and farther on, on the south side of the row, a number of pulleys for the transmission of power.

Next door to the last-named firm, on the south side, Messrs. Willans & Robinson exhibit the well-known three-cylinder high-speed compound engines now so much in use for driving dynamos, fans, and screw-propellers, also an electric governor, a vertical boiler, and a system of fan-draught to quicken combustion in furnaces.

Willans'
3-Cylinder
Engines.

Messrs. J. T. Marshall & Co. show one of their 12-HP. compound semi-fixed engines and boilers in the space next to Messrs. J. & E. Wood on the north side of the row; and proceeding on the same side, Messrs. R. Hornsby & Sons show a 16-HP. horizontal under-type compound engine with automatic expansive gear and annealed steel boiler. The next space on the north side is occupied by Messrs. Hathorn & Co., who show a small locomotive engine, the valves of which are entirely novel and well deserve inspection. On the south side of the above engine Messrs. A. G. Mumford show some steam donkey pumps and marine engines.

In the next space on the north side Messrs. Ogden & Livesay exhibit a steam engine, of the Corliss type, and close by Messrs. Heenan & Froude show the Tower Spherical Engine driving a dynamo direct without the aid of gearing. This motor belongs to the class of rotary engines. The internal mechanism is explained by means of a wooden model, and on the south Messrs. Korting Bros. show a gas engine, injectors which are a specialty of the firm, and patent heating elements. Messrs. Beynon & Cox, of Torquay, also show a gas engine (Wither's patent), and in the next stand Messrs. A. Shanks & Son exhibit a very neat inverted cylinder compound marine engine.

Farther on, Messrs. Walker Bros. exhibit a large air-compressing engine, and on the south side of centre row, Messrs. Browell, Lindley, & Co. show Lindley's high speed governor fitted to engines,—driving

gear for dynamos,—and an engine fitted with the above governor and friction-driving gear. On the north side the Harrison Patent Steering Engine Co. exhibit noiseless steering engines for steam alone, or for steam and hand combined.

Gas
Engines.

The next spaces are taken up with gas engines, the large demand for which type of motor has caused many engineers to turn their attention to its improvement. The British Gas Engine and Engineering Co. exhibit some of Atkinson's gas engines, which are remarkably simple and handy machines; also Atkinson's feed-water heater, and improvements in surface condensers and tubes. Messrs. Edwards & Co. also exhibit improvements in the same class of machinery, as also do Messrs. L. Sterne & Co., who manufacture Clerk's patent gas engine.

Joy's
Valve
Gearing.

Visitors interested in mechanical engineering should not pass over the valve-gearing exhibited by Mr. David Joy, in a stand against the north wall of the Court next the Grill Room door. Mr. Joy's valve-gearing is now largely used both in locomotives and marine engines, and is both ingenious and simple. Models are shown of its application to various types of engines, and also specimens of parts of the gear after prolonged use.

Robey
Engines.

Returning to the centre row, Messrs. Duncan Bros. exhibit some small engines, and close by on the north side Messrs. Robey show one of the now popular type of semi-fixed compound engines, with boiler combined, specially adapted for electric-lighting with Richardson's patent regulator for maintaining either a constant current or electromotive force irrespective of the work done, or the variations in the boiler pressure. The same firm exhibits also a 12-horse horizontal fixed engine, with the Proell Corliss apparatus.

Corru-
gated
Furnace
Flues.

On the south side of Messrs. Robey a mechanical stoker and firebars for feeding furnaces automatically is shown by Messrs. Hodgkinson & Co. The next space on the north is occupied by the Kirkstall Forge Co., who show improvements in shafting, couplings, and bearings. The shafting is rolled so straight, round and true that it requires no turning, its torsional strength is increased 20 per cent., and the strength to resist bending is increased 33 per cent. The couplings are held by friction. In the next stand Messrs. Howard, Lane & Co. exhibit their improved sectional boiler, fitted with an apparatus for illuminating the interior by electricity for the purpose of observing the action under work. In the bottom space Messrs. W. & J. Galloway & Sons show one of their well-known boilers, with some of the side plates removed in order to show the interior arrangements. The space to the south of the Kirkstall Forge Co. contains one of Root's high pressure water tube safety boilers, beyond which is a large trophy of rolled corrugated Furnace Flues for steam boilers, shown by the patentee, Mr. Samson Fox, who also exhibits a rolling mill for the manufacture of corrugated flues and plates. These flues are magnificent specimens of workmanship, and the invention has conferred a real service on boiler makers, by rendering safe the adoption of pressures which would otherwise be extremely dangerous for round furnace flues. In the space at the extreme west end of the Gallery Mr. R. M. Marchant exhibits an engine and boiler, in which he shows the process of retaining and circulating the steam in the engine instead of condensing it or allowing it to blow off.

The foregoing is a description of a few of the principal exhibits in the group of Prime Movers, but it does not pretend to have nearly exhausted the list. There are numerous manufacturers and patentees who show great improvements in the details, fittings, and accessories of engines and boilers and transmission machinery, whose names cannot be mentioned for lack of space, but whose exhibits will well repay careful examination. For exhibits in the grounds to the south of the Gallery, see page 61.

Before quitting the South Gallery some mention should be made of the Dining and Refreshment Rooms, which occupy the space to the south of the gallery at the western end.

The National Training School of Cookery occupies its old situation towards the middle of the Gallery, and will there continue, under the able management of the Lady Superintendent—Mrs. E. Clarke—the useful work which it carried out with so much advantage to the public during the two preceding Exhibitions. In one room a portion of meat or fish, bread and potatoes, is served every day for 6*d.*, from noon till 9 P.M. In the other a dinner of two courses, consisting of either hot or cold joint and pudding, with bread and potatoes, is served on every day from noon till 5 P.M., for 1*s.* From 6 to 8 P.M. a 2*s.* dinner is to be served in the same room. There is the choice of two soups, two fishes, *entrée* or joint, with vegetables, bread and butter, and cheese. On Wednesday a superior dinner will be served for 2*s.* 6*d.* In the Theatre demonstration lessons in various branches of cookery will be given. The subject of the morning lessons, from noon to 1 o'clock, will be high-class cookery; admission 6*d.* From 2 to 3 there will be demonstrations in plain cookery; these lessons will be free. As an illustration of the appreciation in which these dining-rooms were held by the public last year, it may be mentioned that 122,606 dinners were served at 1*s.*, 163,715 dinners at 6*d.*, and 111,965 teas at 4*d.*, making a total of 398,286 meals served. Also 2895 persons attended the 6*d.* demonstration lessons. The provisions consumed amounted to 23,682 lbs. of beef, 1400 New Zealand sheep, and 49 tons 3 cwt. of fish.

Next door to the School of Cookery, Messrs. Spiers & Pond have three rooms. The first is the Exhibition Dining Room, in which are served hot or cold luncheons at 2*s.* 6*d.* per head, from 12 o'clock till 3, and a *table d'hôte* dinner at separate tables, from 5 till 9, at 3*s.* 6*d.* per head. The middle room is a luncheon buffet for the supply of light refreshments, wines, spirits, beer, &c., open till the close of the Exhibition. The end room is the Restaurant, in which dinners and luncheons are served *à la carte* till 9 P.M.

On the north side of the Gallery, opposite the Restaurant, is a grill-room, where chops, steaks, sausages, cutlets, devilled bones, &c., are served from noon till 9 P.M. Leaving the South Gallery by the end door on the north side we find a so-called Machinery Bar, which is a large second class refreshment room, where cold luncheons, teas, coffee, beer, spirits, &c., are provided at moderate prices.

III.—THE QUEEN'S GATE ANNEXE—THE AQUARIUM.

NAVAL ARCHITECTURE—STEEL CASTINGS—CARRIAGES—BICYCLES AND TRICYCLES—THE AQUARIUM—FISH CULTURE.

Queen's
Gate
Annexe.

Naval
Architec-
ture.

Sir W. G.
Arm-
strong,
Mitchell,
& Co.

ON passing the machinery bar the visitor will find a corridor on the left-hand side, which leads to the Queen's Gate Annexe, occupied last year by Belgium. On the present occasion it is given over to Naval Architecture, Carriages and Bicycles (see also page 7). Most of the interesting models of war and merchant ships are situated on the western side of the Court, close to the turnstiles from Queen's Gate. Here the firm of Sir William Armstrong & Co., of Elswick, show a very fine collection of models, some of them being of war ships which have recently excited much attention. Amongst others is the Chilian Cruiser "Esmeralda," built in 1884, of 3000 tons displacement, and 18 knots speed. This vessel is acknowledged to be one of the most useful and powerful war vessels of her tonnage in the world. The armament consists of two twenty-six ton breech-loading guns, two of six tons, and two six-pounder rapid-firing guns. There is also a set of half models of gun-boats of the "Staunch" class, showing the gradual development of the type, commencing with the "Staunch" herself, built in 1867, of a displacement of 160 tons, and a speed of $7\frac{1}{2}$ knots, having an armament of one 9-inch $12\frac{1}{2}$ -ton gun, and ending with the Chinese gunboats "Iota," "Kappa," and "Lambda," built in 1881, of 440 tons displacement, and 10 knots speed, and armed with one 11-inch 35-ton gun, worked and loaded by hydraulic power, two 12-pounder breech-loading guns, and two Gatlings. There are also models of many other cruisers and iron-clads for foreign governments, and also of merchant-steamers, and torpedo boats; in most cases particulars are appended to the models. To one of these models a particular interest attaches at the present moment. It represents the Nile steamer "Safia," built in 1862. The "Safia" was the last steamer abandoned by Sir Charles Wilson at Gubat after his unsuccessful mission to Khartoum.

Thames
Iron
Works.

The Thames Iron Works show a collection of models, of which those of H.M.S. "Warrior" and H.M.S. "Benbow," being the earliest and one of the very latest types of ironclads, will prove most interesting.

Messrs.
Laird
Bros.

Messrs. Laird Bros., of Birkenhead, show a series of models arranged to illustrate the progress in paddle-wheel Channel steamers since 1840, and screw mail steamers since 1852, also models of several early iron steamers.

Admiralty.

The Lords Commissioners of the Admiralty show models of the following ironclads and other war vessels, which very well exemplify the gradual change of type in the ships of the Royal Navy; taken in conjunction with the models of the "Warrior" and "Benbow" above referred to, the series is fairly representative,—the "Monarch," built at Chatham in 1868; "Glatton" and "Rupert," also built at Chatham in 1871 and 1872 respectively; the "Devastation," built at Sunderland in 1875; and the "Inflexible," laid down at Portsmouth in 1874.

Messrs. Samuda Bros. also show two interesting models, one being

the "Riachuelo," a Brazilian ironclad of 6000 tons displacement, speed of $16\frac{2}{3}$ knots, and an armament of four 9-inch 20-ton guns, six $5\frac{1}{2}$ -inch guns, and fifteen machine guns. Also a model of the "Mary Beatrice," a paddle-wheel steamer for the Folkestone-Boulogne service, which it is claimed is the fastest vessel of her class, having attained a speed of 19 knots. The Barrow Shipbuilding Co. also show several half models of steamers. Messrs. Yarrow & Co. show models of the stern wheel steamers "Lotus" and "Waterlily," which have rendered such useful service to the Nile Expedition, and of seagoing torpedo boats built for the Brazilian Government, and the Cunard and White Star Cos. show fine models of their magnificent Atlantic passenger steamers.

Amongst the exhibits relating to boats may be mentioned the self-righting Life-boats, sent by the Royal National Life Boat Institution, and the water-brakes and rudder-propellers invented by Capt. Heathorn, R.A.; the latter improvements are intended to supplement any existing propelling agencies, without offering any obstructions when not in use. The rudder fitted to the cutter is at will "stiff" for sailing (on the balance rudder principle), or, when slackened out, a propeller; preponderance of water-pressure on the largest area producing motion when the rudder is moved to and fro. The row-boat can go up or down any creek which it can float in, and can also hold its touch to the roughest sea by its midship paddles, which can be triced up at will, or left to form very good lee-boards for sailing. Messrs. Simpson & Denisons show a very neatly-arranged steam launch, fitted with Kingdon's patent surface condensing compound steam engine and natural draught boiler.

Life-boats.

Capt.
Heathorn's
Rudder
Propeller.

Amongst the exhibits relating to construction and details of machinery we may mention the crucible cast-steel stern frames and solid rudders,—stern propeller brackets and blades,—crank shafts, solid and built up,—and flexible shaft couplings exhibited by Messrs. William Jessop & Sons. These cast-steel stern frames are coming very much into use as a substitute for forged wrought-iron. The absence of all welds, and the excellent quality of the material, would appear to render the invention very advantageous for shipbuilders.

W. Jessop
& Sons'
Steel
Castings.

A little beyond the Admiralty exhibits is a very interesting apparatus, invented and exhibited by Mr. J. Heck for the mechanical calculation of the stability of vessels. This apparatus consists of a frame supported on knife edges and forming a balance. On one end there is a table working in bearings, and capable of being turned to any desired angle; on this table a hollow or internal model representing the ship to be tested is placed. This model is formed by a number of rectangular pieces of wood about $\frac{3}{4}$ -in. thick, hollowed out to the shape of the cross sections of the vessel at intervals of 20 feet, and kept together by two end pieces and 8 bolts; this gives an accurate mean result, and gets over the practical difficulty and expense of having to deal with a model so long as to be unwieldy. On the other end of the balance there are two scale pans, into one of which weights are placed, so that the whole is in equilibrium when the model is empty of water and at any inclination. The model is filled with water to a height corresponding to any particular draught, and by inclining it to any required angle the shifting of the centre of gravity of the water in the model can be determined by simply noting the weight in the other scale pan necessary

Heck's
Stability
Balance.

to preserve equilibrium, and from the data thus obtained the stability can be easily estimated. The weight of the model, when empty of water, being balanced, counteracts any disturbance in the balance that might be caused by inclining the model, so that only the shifting of the water affects the result. By increasing or reducing the water in the model the moments of stability can be obtained for any draught.

Carriages. The remainder of the Queen's Gate Annexe is given up to Carriages, Bicycles and Tricycles. The number of exhibitors in the carriage department is very large, and comprises many of the best-known names. Many of the carriages exhibited are remarkable for their convenience and the perfection of the workmanship, no less than for the ingenuity of many of the mechanical details. Where there are so many excellent examples of workmanship and design in a class it would be invidious to particularise.

Bicycles and Tricycles. The display of Bicycles and Tricycles is also an extraordinarily good one. The progress made in this new industry during the last few years has been really remarkable. The substitution of the wire tension wheel for the old wheel with wooden spokes was the initial invention which rendered so many other improvements possible. The tricycle, which is the most recent invention, is now being used, not merely for purposes of locomotion, but also as a very useful parcels carrier, and several of these machines fitted up for the service of the parcels post, for the conveyance of milk, and the use of retail tradesmen, are shown. Amongst the most recent improvements is the safety bicycle, which is now manufactured by nearly all makers of repute. One type of this machine has comparatively small wheels, to which the motion is imparted by chain gearing, the crank axle being situated very near the ground, and the gearing so arranged that the principal wheel makes about one and a half revolutions for every turn of the cranks. In another type the cranks are retained on the axle of the principal wheel, but are worked by levers, which arrangement enables the saddle to be placed further back, thus rendering a fall forward more improbable. The Queen's Gate Annexe contains also several fire engines, extinguishers, escapes, and accessories.

Aquarium. Returning now to the main buildings, we enter the Aquarium, which was constructed and stocked with fish for the Fisheries Exhibition at a cost of some £6000, and in the incredibly short space of time of six weeks. The salt water for the tanks containing the sea fish, to the amount of about 65,000 gallons, was brought from Brighton, and clarified through Maignen's patent "Filtre Rapide." It is kept in a state of circulation through the tanks by means of pumps driven by Otto gas-engines, in a pumping station at the southern end of the gallery. The fresh-water fish are kept in tanks supplied with water which has been softened by Maignen's process, for the water supplied by the London Companies is too hard for fish to live in for any length of time. By means of this process the carbonate and sulphate of lime, which render the water hard, are thrown down, and easily removed by filtration through Maignen's large supply "Filtre Rapide." The various tanks contain many interesting specimens of fish, but probably the one which will most attract sightseers is that which contains the collection of Sea Anemones, many of which are of rare beauty. This department of

**Maignen's
Filters.**

the Exhibition has been handed over to the Council of the National Fish Culture Association, the President of which is the Marquis of Exeter, and the manager and secretary, W. Oldham Chambers, F.L.S. The object of the Council has been to render the Aquarium instructive as well as interesting, and consequently arrangements have been made for stocking the tanks with various species of food fishes, in addition to which there is a well-arranged establishment for the artificial culture of marine and fresh-water fishes, molluscs and crustacea. The collection is further enriched by the loan of numerous cases of stuffed fishes.

The Council of the National Fish Culture Association have spared no trouble and expense to still further heighten the attractiveness of the Aquarium, and preparations have been in course of progress since the beginning of the present year for bringing to perfection the several necessary preliminaries, to ensure the successful retention of fish in captivity. During the winter the Aquarium was maintained in such a manner that the collection now shown to the public might include as many well-seasoned and matured fish as possible. Elaborate arrangements have been made for replenishing the tanks with marine and fresh-water fish, and to this end special trawlers are being employed on all parts of the coast to capture and forward specimens, so that the Aquarium may always be replete with carefully selected fish, forming a unique display as far as London is concerned.

In order to still further intensify the interest attaching to the living collection of fish, the Council of the National Fish Culture Association obtained the consent of the Lords of the Committee of the Council of Education to a portion of the magnificent exhibits in the Buckland Museum being transferred to the Aquarium for exhibition. An excellent show of interesting and edifying objects is thus presented to the public tanks, forming a rare and important combination of exhibits hitherto rarely excelled.

The fish culture department, belonging to the National Fish Culture Association, is situated in the western portion of the building, and runs parallel with the Aquarium, containing exhibits of fish-hatching and rearing apparatus invented by the Marquis of Exeter and Mr. W. Oldham Chambers. During the winter and spring this department has been a scene of lively activity, on account of the spawning season, when many hundred thousands of fish eggs were successfully incubated, and the fry transferred to waters at the Delaford Park Fishery belonging to the Association. It is to be regretted that, on account of the time of year, the public were prevented from viewing the hatching operations, which were of a most interesting and instructive character.

In regard to the exhibits contained in this section, on one side is to be seen a tank of large proportions, in which magnificent specimens of salmonidæ of various species, including grayling, are shown, whilst on a line with it is a row of hatching boxes, in which ova are deposited, and the fry maintained until such a time as they lose their *umbilical sac*. Exactly opposite are several tanks in which are exhibited some of the fry hatched last year on the premises, including salmon and trout, which are interesting as affording an idea of the capacity of artificial fish culture. Among other exhibits are a model of an Oyster Culture Establishment designed by the Marquis of Exeter, models of Fish

Culture appliances designed by Livingstone Stone, Esq., H. C. Chester, Esq., M. G. Holton, Esq., W. H. Wroten, Esq., and a model exemplifying the most efficacious and economical method of constructing breeding ponds for fish, invented by Mr. W. Oldham Chambers, F.L.S., all of which are well worthy of note, forming, as they do, edifying and interesting studies, selected from the Buckland Museum.

IV.—EAST AND WEST GALLERIES—ARCADES AND ANNEXES.

MACHINE TOOLS — HYDRAULIC MACHINERY — TEXTILE FABRICS — REFRESHMENT AND DINING ROOMS — IRONMONGERY — GLASS AND POTTERY—INDIA RUBBER — CLOTHING — TOYS AND GAMES — FUEL AND FURNACES — ILLUMINANTS—PRINTING—ELECTRICITY.

Western Buildings. THE West Gallery (which is entered from the Aquarium) has this year been joined with the West Annexe, thus the two, together with the West Arcade, form one commodious building in which the three Groups of Machine Tools, Hydraulic Machinery, and Machines used in the Manufacture of Textile Fabrics are located.

Machine Tools. The south half of the West Gallery is given up to Machine Tools. The best method of seeing this section will be to commence at the south door and to walk up the eastern passage or gangway as far as the large Galloway engine which drives the machinery, and then return by the western gangway.

The first exhibitors at the south end of the row are J. Tushaw & Co., who show apparatus for punching, perforating and shearing plates and angle irons. Next door is a machine for making blocks for lighting fires, exhibited by Mr. T. Onslow. Next comes the space occupied by Messrs. Chubb & Sons, who show a metal-cutting saw and grinding machine for making the frames and bolts of safes, also a model of their factory, and of a patent steel strong-room. The next exhibits are machinery for paint grinding, by Messrs. Brinjes & Goodwin, and for making paper bags and labels, by Mr. F. D. Bumstead. In the succeeding allotment Mr. Kingston shows machinery for cutting and binding firewood. Messrs. Greenwood & Batley show several interesting machines for making those cutters which now play so important a part in mechanical engineering, also milling machines for cutting twist drills, &c., grinding machines for milling cutters, and a machine for shaping bevel wheels. Messrs. Hulse & Co. also show several milling machines, lathes, planing and drilling machines, &c.

Milling Machinery. Messrs. Samuel Worssam & Co. show wood-working machinery; amongst other things a four-cutter general joiner, and a rope and roller feed saw-bench. Mr. H. R. Marsden exhibits his well-known stone breaker and pulveriser.

Wood-working Machinery. Messrs. Powis & Co. show a universal joiner and a tool for the manufacture of gun-stocks, banister-rails, shoe-lasts, &c., also a model

of a steam navy. Messrs. Brunton & Frier have several tools for working and polishing stone. Messrs. H. C. Duffy & Son show wood-block flooring and paving, and also planing, jointing and chamfering tools. In the space next to the large engine the well-known firm of A. Ransome & Co. have a fine collection of wood-working and tree-felling machinery.

Returning now by the western side of the Gallery we find the following amongst the more important machines exhibited:—Messrs. Harpers show a useful machine for cutting keyways in wheels, pulleys, &c. A little way farther on Messrs. John Spencer & Co. show a similar machine. Mr. J. Templeman exhibits improvements in the manufacture of fire-lighters. R. Broadbent and Son have an improved Blake stone-breaker and instantaneous grip belt-fasteners. Farther on John Watts & Co. show a double band-saw for deep cutting, which takes two cuts simultaneously. Messrs. Holden & Brooke exhibit their improvements in injectors, and also a portable boiler-drilling machine. Machinery for turning and screw-cutting is shown by Thomas Shanks & Co. At the next stand Mr. Newell illustrates the process of embossing tinware, and towards the end of the row Messrs. Minton exhibit improvements in the manufacture of pottery. No branch of manufacturing industry has been so conservative and so slow in the introduction of machinery as the pottery trade. The manufacture of cigars and cigarettes will interest many visitors, and is shown in the end space. The west wall of the Gallery is also occupied with exhibits, many of which are well worth visiting.

From the bottom end of the Court the visitor can pass into the West Annexe, which is given up to hydraulic machinery (see also page 9). In this case also the best plan to see the principal exhibits will be to commence at the south end of the Court, and to proceed by the right-hand gangway. At the commencement of the row Messrs. Worthington & Co. show their steam pumps, water motors, and water meters. Closeby, against the east wall of the Court, Messrs. Price & Co. and Messrs. Field & Co. show machinery for the manufacture of candles, night-lights, soaps, &c. Farther on, on the right-hand side, Messrs. Fielding & Platt show Tweddell's system of hydraulic machines for riveting and other mechanical operations, also a high speed rotary steam engine for launches, dynamos, &c. On the left hand side the East Ferry Road Engineering Works show models of hydraulic cranes, lifts, and weighing-machines. Messrs. Atwood & Co. exhibit direct acting hydraulic lifts, and hand-power lifts and hoists. Messrs. Horn & Sons have a patent four-slide exhauster, and pump for gas, air, and liquids; and Messrs. J. Ladd & Co. show presses for baling goods. In the next stand, Messrs. Hathorn, Davey & Co. exhibit an interesting little domestic motor, or safety engine, for pumping, electric lighting, &c. This motor is a vacuum engine of simple construction, its power being derived from the condensation of steam at the atmospheric pressure. It has a small generator in which the pressure of the steam cannot exceed that of a boiling tea-kettle. It is therefore perfectly free from the risk of explosion. The vacuum is produced by a small supply of cold water, the quantity required being about one gallon per minute per horse-power; the water may be used over and over again. These motors are made as small

**Hydraulic
Machinery.**

**Domestic
Motor.**

as $\frac{1}{4}$ H-P. Farther on, Selig, Sonnenthal & Co. have several interesting machine tools. At the next stand, Messrs. Glossop & Stacey show three small steam hammers, and, farther on, Mr. B. Smith has a telescope hoist and hydraulic crane. The well-known firm of Sharp, Stewart & Co. exhibit several machine tools and improved Giffard's injectors.

Reverting to the right hand side, Messrs. Beck & Co. exhibit in the space beyond the doorway a rotary pressure blower for cupolas, furnaces, &c., and also a rotary pump, which runs at slow speeds, and has only two moving parts. At the next stand Messrs. Appleby Bros. show several cranes and a model of a quartz reduction mill. Messrs. John Warner & Sons have a chain pump,—a steam pump condenser and steam pump, and an expansion gear. Messrs. Hugh Smith & Co. show an important collection of hydraulic machinery, including accumulators, cranes, and various classes of riveting machines used in the manufacture of ships. The Hydraulic Engineering Co. also exhibit several machines, including compound steam pumping engines, hydraulic capstans, engines, cranes, lifts, accumulators, and machine tools. Mr. R. Waygood has a large collection of lifts and a patent rotary engine. The Pulsometer Engineering Co. exhibit a large pulsometer, which is a pistonless and frictionless steam pump with no moving parts but the very simple valves; the machine acts by the direct pressure of the steam on the surface of the water contained in the chambers. The same firm exhibits the Deane direct acting pumping machinery for high lifts, and also a filter for purifying continuously large masses of polluted water.

**Tangye
Brothers.**

Messrs. Tangye Bros. have a large show at the end of the Court. Amongst their numerous exhibits we may mention the following: a colonial steam engine with automatic expansion gear,—a direct-acting centrifugal pumping engine,—a Tangye gas engine,—a gas hammer,—hydraulic lifting and pulling jacks,—a special steam pump,—and a compound condensing pumping engine. In the next space to Messrs. Tangye Mr. T. Williams exhibits a direct-acting steam pump.

**Easton
and
Anderson.**

Returning towards the southern end of the Annexe, we find the two first spaces given up to hoists and lifts exhibited by Messrs. J. Barker & Sons, and Messrs. A. Smith & Stevens. Next comes an important collection contributed by the well-known firm of Easton & Anderson, who show one of Rich's turbines working a centrifugal pump; also parts of the lifts for the Mersey Tunnel Railway, each of which lifts can raise from 80 to 100 people. The same firm show high-pressure air-compressing pumps, for charging torpedoes, and a model of a patent hydraulic ferry steamer for tidal rivers. Mr. Henry Coles shows a steam crane with improved slewing gear, and also a patent grab and bucket dredger. Messrs. Anderson & Gallwey show several hydraulic riveters and machine tools; and Messrs. James Kite & Co. high-pressure filter-presses. Messrs. Körting Bros. exhibit a new steam pump, called the aquapult. The Phoenix Metal Die and Engineering Co. have steel dies for hot forgings and stamping in metals. The Westinghouse Brake Co. show their direct acting pumps for air or water, and Messrs. Lines & Bridgman a machine for nailing boxes. In the next stand, Mr. S. George exhibits a very ingenious little rotary pump, which is reversible, and

will run at a slow speed. Messrs. S. Chatwood show elevators, and Messrs. Clark, Bunnet & Co. exhibit a duplex hydraulic lift, with pumps and accumulators.

Having gone through the hydraulic machinery, the visitor can now find his way to the department of Textile Fabrics by walking back to the large Galloway engine in the middle of the West Gallery (see page 9).

This magnificent double-cylinder compound engine has been kindly placed by Messrs. Galloway & Sons at the disposal of the Executive Council for the purpose of driving the machinery in motion in this Gallery. The engine is of the horizontal type, the two cylinders being placed alongside each other, and the piston so arranged as to be simultaneously almost at the opposite ends of the stroke, a plan which ensures great steadiness of twining. The cubic contents of the cylinders are as 1 to 3, the high pressure being 14 inches, and the low pressure 24 inches diameter, the stroke of both being 30 inches. There is a link valve motion, and a powerful parabolic governor. A condenser is usually placed in rear of the engine, and is worked by the continuation of the low-pressure piston-rod. The boilers, which generate steam for the use of this engine, are in an adjoining building, the Western Annexe, and will be referred to later on.

Close by, in the north end of the West Annexe, are the two fine boilers lent by Messrs. Galloway & Sons, already referred to. These are of the well-known Galloway type, the flues provided with circulating tubes; they are of steel throughout, 26 feet long and 6 feet 6 inches in diameter, and are suited for a pressure of 80 lbs. to the square inch.

The firm who occupy the space next to the engine are Messrs. Mather & Platt. They show a sampling machine for making combinations of colours and designs on short lengths of cloth to show effects; also a continuous bleaching machine for use in Thompson's bleaching process, to supersede the chloring operation as hitherto practised, and lastly a soaping and washing machine for cleansing printed cloth from the gums and thickening used in printing colours. Proceeding by the right-hand gangway we find Messrs. Taylor & Sons' space on the left-hand side. This firm exhibit mechanism for actuating the healds of looms,—an improved joint for heald levers,—and mechanism for actuating the rising and falling of boxes of looms. In the next space Messrs. J. Farmer & Sons show a creasing and measuring machine,—a universal calendar, upon which the following finishes can be produced, viz.: chasing, frictioning or glazing, swizzing, embossing, and Moiré lustre,—an apparatus for washing, bleaching, scouring, soaping, and dyeing woven fabrics,—and a model of machinery for treating town refuse. Messrs. Lawson & Sons show an automatic spinner for rope-yarn. Messrs. Watson & Laidlaw have centrifugal hydro-extractors,—apparatus for bleaching sugars and other granular substances, and details of machinery. Mr. George Daughters shows a double-action hair-carder, for carding curled hair, old hair, and fibres, without breaking. Mr. Thomas Thorpe exhibits a doubling machine, with upright spindles and stop motion, for running two threads together without twisting on to spools or bobbins, and a winding machine with upright spindles and damping apparatus for winding from hank on to

spools and bobbins. At the top of the row Messrs. John Bell & Son show the art of spinning asbestos fibre by itself without the aid of other fibres.

Textile
Fabrics.

Returning now towards the engine by the other gangway, we have exhibitors on both sides. In the centre row, on the left, Messrs. Howell & James show an Irish hand-loom, with a linen-weaver at work, also samples of Irish linen and flax. On the right-hand side Messrs. Gauntlett & Co. show carding machines, one for woollen and cotton flocks, and the other specially made for hair and fibrous material only. In the next space on the same side the Asbestos Co. show their machine for making gland-packing from asbestos. Behind these two firms Mr. Anderson Laing exhibits a winding machine with self-acting oiling and damping machine combined. In the next space Messrs. Samuel Brooks have a large and most interesting exhibition of improvements in drawing-frames for cotton,—ring spinning-frames for both warp and weft yarn,—a ring doubling-frame,—a winding-frame and reel. On the other side of the gangway, in the centre row, the McNary Machines Co. exhibit improvements in machinery for the manufacture of wool, cotton, hemp, and jute fabrics,—also various fabrics, seamless hats, and bag-shaped articles. On the same side Messrs. Hacking & Co. show looms for weaving checks with a 4-shuttle motion,—a loom for weaving trouserings,—a machine for folding and measuring, and a machine for winding cotton yarn. On the opposite side, Professor Hele Shaw exhibits sphere and roller mechanism for the transmission of power; and close by, Messrs. Walter Glover & Co. show James' patent machine for making cord fishing lines, gold thread, bullion fringe, &c.—also a rope-making machine,—a rope pulley friction brake, &c. Messrs. Broadbent exhibit a conical drum-winding machine for winding yarn on paper tubes, and also instantaneous belt fasteners. Messrs. A. Haacke & Co. exhibit braiding machines for the manufacture of non-conducting ropes filled with fossil meal and samples of fossil meal and Kieselguhr. In the centre row Mr. G. Hodgson shows power looms. Messrs. H. Livesay also show modern looms, and, as a contrast, a loom made half a century ago. At the bottom of the centre row Messrs. Treloar & Sons show a machine for making coir plaits for door mats. It may here be mentioned that during the last two years Messrs. Treloar have kindly supplied the Executive Commissions with the door mats used throughout the buildings, and of such excellent quality that in spite of the enormous traffic they have not shown the slightest signs of wear. On the present occasion they have again come forward in the same manner, and as a novel feature, have worked the word "Welcome" and its equivalent, in numerous foreign languages, into the centre of the mats. On the right hand side, Messrs. Parry & Rocke exhibit Welsh knitting yarns and hand-knitted hosiery, manufactured by attendants in the national Welsh costume.

Treloar's
Door Mats.

The visitor can now proceed northwards by the Western Arcade towards the Quadrants which skirt the Gardens. The Western Arcade itself is full of exhibits in the textile group, which, at the moment of going to press with the first edition of the Guide, were not sufficiently advanced for description. On ascending the flight of stairs at the end of the Arcade we pass through the West Refreshment Pavilion, which



GENERAL VIEW OF THE GARDENS



is used for the service of cold luncheons, tea, coffee, ices, &c. Adjoining is a Lager-beer counter and American bar. Over the West Quadrant is the Club Dining Room, which overlooks the Gardens. Access to this room is obtained by the stone staircase in the Conservatory. In it are served dinners of a superior character from six to nine o'clock at the fixed price of 7s. 6d. per head.

West
Refresh-
ment
Pavilion.
Club
Dining
Room.

The West Arcade houses three groups in the following order, proceeding towards the Conservatory, Cutlery and Ironmongery,—Pottery and Glass,—India Rubber. He will not fail to observe the fine collection of pottery contributed by Messrs. Doulton & Co., and the crystal and coloured glass exhibited by Messrs. T. Webb & Sons. The visitor who is interested in the above subjects will be able readily to appreciate the value of the objects exhibited by an inspection of them. At the end of the Quadrant, close to the Conservatory, is the magnificent installation of Siemens' dynamos, together with their engines and boilers, used in lighting up the thousands of electric lamps employed in the illumination of the Gardens. This installation will be again referred to under the heading of Electric Light.

Siemens'
Dynos.

For Loan Collection of Musical Instruments, Manuscripts, &c., on view in the Albert Hall, see page 55.

Crossing through the Conservatory the visitor finds himself in the East Quadrant, which contains the remainder of the India Rubber group, and also the departments of Leather, Clothing, and Toys and Games. The subject of clothing was very completely dealt with last year, and has consequently not received much space on the present occasion. The majority of the exhibits are readily understood by mere inspection. There are a few machines shown in this department, such as washing, boot-making and sewing-machines, also knitting and pleating-machines.

East
Arcade.

Clothing.

Mr. Henry Heath, of Oxford Street, exhibits the manufacture of silk hats in its different stages. The process of making the seams and finishing a silk hat is an operation requiring a great deal of delicate work and skill, no joining of the silk must be visible.

Hat-mak-
ing by
Heath.

The space devoted to toys and sports contains many exhibits relating to our principal out-door games; also some magic lanterns, and some excellent billiard tables by renowned makers.

Toys and
Games.

At the south end of this Arcade is a Refreshment Pavilion, of exactly similar character to the one in the West Arcade. While over head are the Temperance Refreshment Rooms, in which cold luncheons and light refreshments can be obtained at all hours at popular prices. No intoxicating liquors are sold here. These rooms, like the Club Dining Rooms, are likely to be frequented, commanding as they do splendid views of the grounds.

Refresh-
ment
Pavilion
and Tem-
perance
Refresh-
ment
Rooms.

Descending the flight of stairs, the visitor finds himself in the East Arcade, the portion of which he enters first being reserved for the subject of Fuel and Furnaces. This group has been fully illustrated in the late Exhibitions, and has therefore but little space allotted to it. Gas fire-places, cooking ranges and stoves occupy a prominent position in this section. The most important exhibit is, however, an improved form of regenerative gas furnace and gas producer, exhibited by Mr. Frederick Siemens.

East
Arcade.

Fuel and
Furnaces

Gas and
other
Illumi-
nants.

As the visitor proceeds southwards, the next Section of the East Arcade is given up to gas and other illuminants. Messrs. George Waller & Co.—J. Somerville—and Kirkham and Clark, exhibit gas-making apparatus, or improvements in the details of such machinery. Messrs. C. Hearson & Co. show the Sun Gas-making Machine for two hundred lights. This machine makes gas from gasoline. Messrs. W. Sugg & Co. exhibit a variety of their well-known burners, governors, photometers, &c. In the Oil Lamp Section the most interesting exhibit is Defries & Sons' new safety lamp. It gives a perfectly white light of great power, emits no unpleasant odour, and is so constructed that it is inexplosible, even when upset. Any ordinary American oils can be used with this lamp, the use of refined oil being quite unnecessary. The two refreshment rooms adjoining "Old London" are illuminated by these lamps.

East
Gallery.

Chinese
Exhibi-
tion.

There are several doorways leading from the East Arcade into the East Gallery, and the visitor will do well to inspect this portion of the buildings next. The northern half is reserved for China, and the collection contributed by that country will be found to be one of the most interesting features in the entire Exhibition. The walls and roof of the Court are beautifully coloured by Chinese artists, and are hung with Chinese lanterns and coloured flags; the walls are richly decorated with porcelain plates, educational pictures, and specimens of old arms and armour, conspicuous amongst the latter being the striped black and yellow tiger clothing of the old soldiery. The writings of many of the symbols on the walls were executed by the Chinese Ambassador the Marquis Tseng, who is famed for his skill in caligraphy. On either side of the central passage are beautifully carved shop fronts, which are exact reproductions of those in actual use in the cities of Peking, Kienkang, Canton and Hankow. Between the shop fronts on either side of the central gangway are sedan chairs adapted for mule transport. Close by, on both sides are cases of Chinese boots, the absurdly small size of some of which afford one more proof of the ridiculous results which may be produced by fashion. On both sides are some cases of beautiful soapstone ornaments. Farther on the visitor will find on his right-hand a bedroom with two beds beautifully curtained, one for summer, the other for winter use, together with a complete set of bedroom furniture. On the left-hand side are the magnificent appointments of a *salon*, consisting for the most part of ebony and marble couches, chairs and tables, reversible stools, the side for summer use being of straw, that for winter of a warm material. The carpet, which is most beautiful, is also of Chinese manufacture, as are the metal charcoal hand and foot warmers.

The wall-cases beyond these contain a collection of Chinese books, many of them being of an educational character; there is also a series of rubbings from old tablets, some of which are two thousand years old. The Chinese are famous for their study of literature; they were the original inventors of competitive examinations. Lately they have taken to the study of modern sciences, and many of the books exhibited are translations of European text books. The wall-cases round the Northern end of the Court are filled with wax figures, draped to illustrate the summer and winter clothing of various ranks in Chinese society. There

are over thirty of these figures fully clothed, not merely with the outer garments, but with complete underclothing in addition. Many of the figured silks and embroideries are of very beautiful design and work, and are worthy of the closest attention. The floor of the North end of the Court is occupied on the one side by a gorgeous bridal palankeen, and on the other by a catafalque covered with exquisite embroidery. The palankeen is represented with its bearers. There is also a Pekin cart with a figure of its driver; the harness and metal-work are of very fine workmanship.

Flanking the Chinese Court, and looking out on to the Grounds, is a handsomely-decorated Chinese restaurant and tea-room, which was erected by Messrs. Holland. It is surrounded by a spacious verandah, and contains a dining-saloon, with balcony, a tea-room, and kitchens. According to the Chinese theory, when a man goes to a restaurant he ought to feel cheerful, sociable, and happy; and on the other hand, he goes to a tea-room to reflect, or to indulge in sober and earnest conversation. Accordingly we find the decorations of the two rooms reflect these ideas. The dining-room is very gay, full of light and colour, and the tea-room is relatively sombre. The artificial flowers used in the decoration of the frieze are made of pith, and come from Amoy. The wall decorations represent vines and other creepers, and the door leading out to the terrace is a fine piece of carving, executed by a Chinese artist named Teh-et-Kene, at present residing in this country. The restaurant and tea-room are only to be approached through turnstiles. The accommodation being limited, a charge of one shilling is made for each person, which includes tea or other light refreshments. The rooms are this year in the occupation of Messrs. Spiers & Pond.

It will be convenient to go over the southern half of the East Gallery before continuing along the remainder of East Arcade. In this Section are collected together the exhibits relating to Printing, Paper, and Bookbinding (see also page 13). They consist for the most part of machines for printing,—folding, cutting, and stitching paper,—lithographic stones, and processes employed in lithography and photo-lithography; also copying apparatus, paper, and the raw material from which it is produced, &c. The best way of seeing the principal exhibits in this Gallery is to walk southwards by the gangway on the right hand, or west side of the Court, returning by the other side. The first exhibitors passed are Messrs. Newall & Son, who exhibit mechanical and chemical wood pulps, and wood flour used in the manufacture of paper, linoleum, &c. Messrs. Sprague & Co. show an ink photo process, and photo-lithography. Mr. J. Ayling shows an improved apparatus for preparing drawing or transfer paper, which being photographed or lithographed upon a zinc plate produces illustrations for use with type; the whole process of making the blocks is shown daily, from the artist's drawing to the finished block. Messrs. Horne show improvements in the manufacture of luminous paper, and also paper-folding machinery, a wire-stitching machine, and an engraving machine for hatching work. Mr. J. Salmon exhibits a printing machine with patent taking-off apparatus, and web feeding attachment,—a lithographic printing machine,—and also cutting and stitching machinery. Nearly all the machines in this Section are driven by powerful gas-engines.

East
Gallery.
Printing,
Paper and
Book-
binding.

Messrs. Furnival & Co. also exhibit various printing machines; also a hot and cold rolling machine for glazing and finishing paper. Messrs. W. Crossland have several cutting and cornering machines; Messrs. Newsum, Wood, & Dyson an Anglo-American litho machine; and Messrs. J. S. Virtue, copperplate printing press, at work on etchings for the 'Art Journal'; also specimens of etchings and line engravings. Mr. F. R. Daldy shows a sewing machine which sews at the rate of 18,000 sheets per day, either on tape or cord; also a book-sawing machine adapted to the above.

'Illustrated
London
News' and
'Graphic.'

At the south end of the Gallery are two highly interesting exhibits. The first, exhibited by the proprietors of the 'Illustrated London News,' is Harrild & Sons' Registered Fine Art Two-feeder "Bremner" printing-machine. The second is by the proprietors of the 'Graphic,' and illustrates improvements in printing machinery and the various processes involved in the whole method of producing a high-class illustrated newspaper.

Returning now by the east side of the Gallery, the visitor will notice on the right-hand side the important exhibits of Messrs. Waterlow & Sons, which include blocks for printing from, produced by various photographic processes—the Woodbury type printing process, presses for printing the same, and examples of engraving on steel and copper.

Messrs. Harrild & Sons also have a large collection of Bremner machines,—stereotype foundry corebars, and metal furniture moulds,—also printers' joinery and utensils. Messrs. G. Mann & Co. exhibit the Climax lithographic printing machine, with damping and taking-off arrangements. Mr. Dallas shows the so-called Dallastype and Dallastint photo-graving, chromo-Dallastint,—glass engraving,—and a process for engraving metals without etching by acids, an application of Croker's hot pen. Messrs. Umpherston show a rag engine for paper pulp.

There are various other appliances connected with the stationery trades to be seen in this department, both in the Gallery and the Arcade, which the visitor will do well to examine.

Electricity.

On re-entering the East Arcade the visitor at once finds himself in the space allotted to Electricity. This is one of the most interesting and important sections of the Exhibition, many of the best known inventors and manufacturers exhibiting (see also page 10).

Almost the first stand encountered in this part of the Gallery is in the occupation of Mr. J. W. Swan, the inventor of the celebrated incandescent lamp which bears his name. He exhibits the Swan Lamp in various sizes, and applied to various purposes. These lamps can now be had in powers ranging from $2\frac{1}{2}$ up to 100 candles. Amongst them is a small lamp for illuminating the internal cavities of the living body during operations. Mr. Swan also exhibits a new process for the production of perfectly uniform carbons for incandescent lamps. The filaments are produced from a liquid by pressure through a die. He also exhibits an electric meter, consisting of the combination of a galvanometer and a clock, which indicates on dials, similar to those of a gas-meter, the amount of electricity used by each consumer. Close by, Messrs. Laing, Wharton & Down exhibit the Thompson-Houston system of arc lighting. The lighting of the whole of the East Gallery, including the Chinese Court and the printing departments, is carried out on this system, and appears to be one of the most satisfactory

installations in the entire Exhibition. The invention has only just been imported from America. The system is remarkable for the extreme steadiness of the lamps, and the automatic regulation of the dynamo. A little way down the Arcade the Consolidated Electric Co. show the B T K system of electric lighting from storage batteries, and of distribution of electricity from a central station for house-to-house lighting. Nearly opposite, on the right-hand side, Mr. G. Trouvé shows his well-known primary batteries, an electric motor, and models of electric boats, and an electric tricycle. On each side of the way, for some distance down, are numerous cases containing various fittings, and appliances relating to electric lighting, telegraphs, telephones, motors, batteries, and dynamos, which are well worth visiting.

On the left side, about two-thirds of the way down the Arcade, **Primary Batteries.** Mr. Maxwell Lyte has an exhibition of Primary Batteries, showing their application to transmission of power, telegraphy, and house lighting. There are a great many varieties of primary batteries on view in the Exhibition, and amongst them one of the most remarkable is the Holmes Burke battery, exhibited by Mr. O. March, on the right-hand side, nearly opposite to the last-named stand. The battery is shown in its application to electric lighting and to driving a motor. The motor in question is of the electro-magnetic type, and is a very useful one for small and moderate powers. The Holmes Burke 8-cell battery shown by Mr. March keeps 14 Swan 5-candle lamps brilliantly illuminated. The arrangements for filling and emptying, for making the electric connections, and for getting at the plates, are of a very simple and practical character, and constitute most important improvements.

On the left side, opposite to Mr. March's stand, the celebrated **Anglo-American Brush Co.** show all their latest improvements in the manufacture of arc and incandescent lamps, their holders, carbons, and fittings, and in the construction of dynamos, motors, and their armatures. Beyond them the Electric Power Storage Co., who have done so much for the improvement of secondary batteries, exhibit a **Electrical Power Storage Co.** large number of their storage cells of various types; also some motors, and a model of the electrical tram-car which has been run with so much success on their experimental line.

On descending the steps at the end of the Arcade the visitor will find several other important electrical exhibits. On the left-hand side the Edison & Swan United Electric Co. show dynamo machines. On the right Mr. Fergusson exhibits the interesting zinc and copper oxide batteries of the Chapeyron Lalande type, also motors, lathes, lamps, &c. In the left-hand corner Messrs. Woodhouse & Rawson have a very **Woodhouse and Rawson.** interesting collection of incandescent lamps, measuring instruments, switches, automatic cut-outs, and other accessories. The speciality of this firm is an incandescent lamp, taking a relatively small amount of electric energy to produce the light. One interesting feature of their collection is a group of thirty lamps worked by a dynamo, which in its turn is driven by another dynamo acting as a motor; the latter receives its current from another dynamo, driven by a water motor at a considerable distance.

Messrs. Paterson & Cooper show the new Phoenix dynamo, also arc-lamps, measuring instruments, motors, and other accessories. Messrs.

R. E. Crompton & Co. exhibit the successive improvements in the Crompton-Burgin and Crompton-Kapp dynamo machines, which have resulted in a greatly increased output and efficiency. The same firm show improvements in measuring instruments in arc-lights and accessories. On the opposite side Mr. Taylor Smith shows his ingenious domestic fittings for electric lighting.

East
Annexe.

Parallel with the East Gallery, but separated from it, is the East Annexe, which is given up exclusively to Group XVII., which embraces food, cookery, and stimulants. This Group was very fully dealt with in the Health Exhibition. Amongst the novelties exhibited are folding-tables and seats, which are very convenient for picnics, &c. They are shown by Mr. Baker, the well-known gun-maker.

V.—CENTRAL BUILDINGS.

OLD LONDON—PRINCE OF WALES' PAVILION—FURNITURE—JEWELRY—
WATCHES AND CLOCKS—PHOTOGRAPHY—INSTRUMENTS—CHEMISTRY
—AUSTRIA — JAPAN — SIAM — FOREIGN COUNTRIES — AMERICA —
WALTHAM WATCHES — RUSSIA — MUSIC — LOAN COLLECTION OF
MUSICAL INSTRUMENTS, &c.

THE Visitor has now arrived at the point from which he started, and there still remain the central buildings to be inspected. The best way of visiting these is to proceed along the South Gallery to its middle point, then to turn to the left and proceed up the Central Avenue. "Old London" will be found on the left hand, and the Prince of Wales's Pavilion on the right.

Old
London.

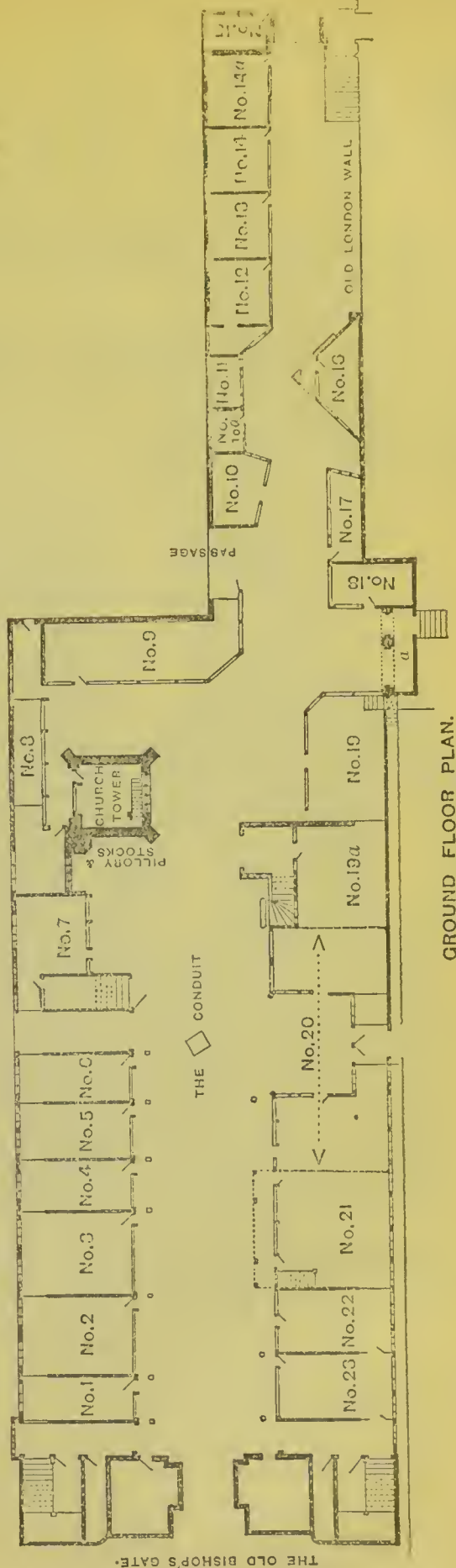
The "Old London" Street is sure to be this year, as it was last, one of the most popular features in the Exhibition. The following account of it is taken from the Official Catalogue, and is based upon the description written by Mr. George Birch, F.R.I.B.A., from whose designs and under whose superintendence the street was erected :—

Entering from the Central Avenue, immediately in front of the Pavilion of His Royal Highness the Prince of Wales, stands one of the City Gates—Bishopsgate, reduced in proportion and flanked by the City wall; this gate (not one of the original gates, of which there were but four) was broken through the ancient walls, the peculiar Roman manner of building, with courses of tiles, being shown on the lower part. Above the arch on each side are the arms of the City of London and the arms of the Bishopric, and immediately over the gate, in a niche, stands the statue of one of the bishops, William the Norman, to whom the City was particularly indebted, for by his good offices all those rights and privileges and immunities which the City had inherited from Roman times, and which had been confirmed and strengthened under the Saxon Kings, were reconfirmed by the Conqueror. Above, on the towers which flank the gateway, are the statues of Alfred, who wrested the City from the Danes, and of his son-in-law, Aldred Earl of Mercia, to whom he committed the government thereof.

Passing through the gate, the corresponding statue, that of William the Norman, is seen, representing St. Erkenwald, the Fourth Bishop of London, A.D. 675, after the reconstitution of the see and re-establishment of Christianity by St. Augustine. The ground floor on each side shows on the right a debtor's prison, and on the left an

THE "OLD LONDON" STREET.

1. ROSE INN, FENCHURCH STREET.
2. COCK TAVERN, SOUTH SIDE OF LEADENHALL STREET.
3. "THE THREE SQUIRRELS," FLEET STREET.
4. DITTO.
5. DITTO.
6. ISAAC WALTON'S HOUSE.
7. HOUSES, BISHOPSGATE STREET.
8. PORTION OF BUTCHERS' ROW.
9. MIDDLE ROW, STRAND, GUNPOWDER PLOT HOUSE.
10. DUKE OF SULLY'S HOUSE.
- 10a. OLD HOUSE, BISHOPSGATE STREET WITHIN.
11. DITTO.
12. OLD HOUSE, GOSWELL STREET.
13. DITTO.
14. OLIVER CROMWELL'S HOUSE.
- 14a. HOUSE IN LITTLE TOWER HILL.
15. HOUSE, KING STREET, WESTMINSTER.
16. HOUSE IN LITTLE MOORFIELDS.
17. HOUSE CORNER OF HOSIER LANE, SMITHFIELD.
18. DITTO.
- 18a. GATEWAY, HOLY TRINITY, ALDGATE.
19. FOUNTAIN INN, MINORIES.
- 19a. HALL OF THE HOLY TRINITY, ALDERSGATE STREET.
20. WHITTINGTON'S HOUSE.
21. HOUSES IN BANKSIDE.
22. HOUSE, HIGH STREET, BOROUGH.
23. DITTO.



Old
London.

ordinary lock-up, and beyond are the staircases to the first-floor. After passing through the gateway, the first house on the left is the "Rose Inn" (No. 1), Fleet church Street, curious as having its front covered with small cut slates, instead of the ordinary lath and plaster and timber construction usual in London.

The next house (No. 2) stood in Leadenhall Street, and was known as the "Cock Tavern." The representations of this house, of which there are many, represent it after the gable had been removed, and a flat coping substituted, but in this instance its pristine condition has been reverted to. Following in order is a block of three houses (Nos. 3, 4, and 5) formerly existing in Fleet Street, towards Temple Bar, on the south side, and known by the name of the "Three Squirrels," now Messrs Gosling's Bank.

The house (No. 6) is a copy of the one which stood at the corner of Fleet Street and Chancery Lane, and was traditionally known as the "Isaac Walton's house," "*Vir et Piscator optimus*," but there is a doubt that tradition in this case was tradition only, as the actual house was two doors further to the west; but apart from this, the house itself was a magnificent specimen of an ordinary citizen's house in Elizabeth's reign, and was for many years a conspicuous ornament to Fleet Street, and in close contiguity to those well-known haunts of the wits of the period, the "Apollo" and the "Devil" Taverns.

Set back a little from the main line of the street, in order to give prominence to Walton's house, and to give it the appearance of a corner house, are two unpromising wooden structures (Nos. 7 and 8), which formerly stood hard by the ancient church of St. Ethelburga, Bishopsgate Street, and were the ordinary type of hundreds of others in the old City, a shop below, and a solar or chamber above.

Standing prominently in advance of these is the old tower of a church, which although not strictly modelled from that of All Hallows Staining, differing only in having a larger traceried window, resembles in its general form and outline many others in which our forefathers were wont to worship. Most of these churches were small, for the parishes attached to them were also diminutive, and the tower type, with bold octagonal staircase turret on one side, was almost universal. There were exceptions, in which the towers had lofty pinnacles at each corner, like the present St. Sepulchre's, Holborn, or the more modern re-buildings by Wren, of St. Michael's, Cornhill, and St. Mary, Aldermanbury; and the curious archaic superstructure with its five lanterns of St. Mary-le-Bow, or de Arcubus, and the very fine spire of St. Laurence Pountney; but the generality of the churches possessed towers similar in character to the one depicted here.

Next to the church, and fronting down the street, is a portion of the Middle Row (No. 9), which stood in the Strand, just outside Temple Bar, and was known as Butchers' Row. These houses well represent the overhanging of the stories so prevalent in London where the ground-floor space was very limited, additional room above being obtained by these means at the expense of light and air.

Elbow Lane.—The site at this point considerably narrows from 70 to 30 feet, and the houses are not continued on parallel lines, in order to break a perspective which would have been too long for a picturesque effect, and also in order to obtain the sinuosity so characteristic of London streets.

Next on the left is a fine large house of two gables (No. 10) which stood in this Middle Row, Strand, and was known as the French Ambassador's house, of the Duke of Sully's; also Monsieur Beaumont's, both ambassadors here from the Most Christian King to the Court of St. James. This Duke de Sully was the famous Henri de Béthune, the wise and popular Minister to Henri Quatre, King of France and Navarre. That this house was probably occupied by him there can be little doubt; not only from the commonly accepted tradition, but from the fact of its being decorated with badges of the De Béthunes, the French crown and fleur-de-lis, and two hands grasping one another in a true "*entente cordiale*."

The next (No. 11) is a low structure of wood and plaster, and has been modelled from an old engraving representing a portion of Bishopsgate Street.

Beyond this is an old house (Nos. 12 & 13) which was in Goswell Street, of the date of Elizabeth's reign. The windows are mullioned and transomed, and show one peculiarity very general in old London, in carrying on the upper lights continuously.

No. 14 is a timber house with carved bargeboard, which stood next to Blue Boar Head Yard, King Street, Westminster.

The last house (No. 14a), decorated with medallions of the Roman Emperors in plaster, stood on Little Tower Hill. There is nothing remarkable in the building.

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CANVAS
CLOTHS.
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THE
"KOH-I-NOOR"
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ETC., ETC.



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Old
London.

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Set back a little from the main line of the street, in order to give it the appearance of a detached building, is a group of three old-fashioned wooden structures (Nos. 7 and 8) which were the church of St. Dunstons.

TIGHT GUTTERS

HERE

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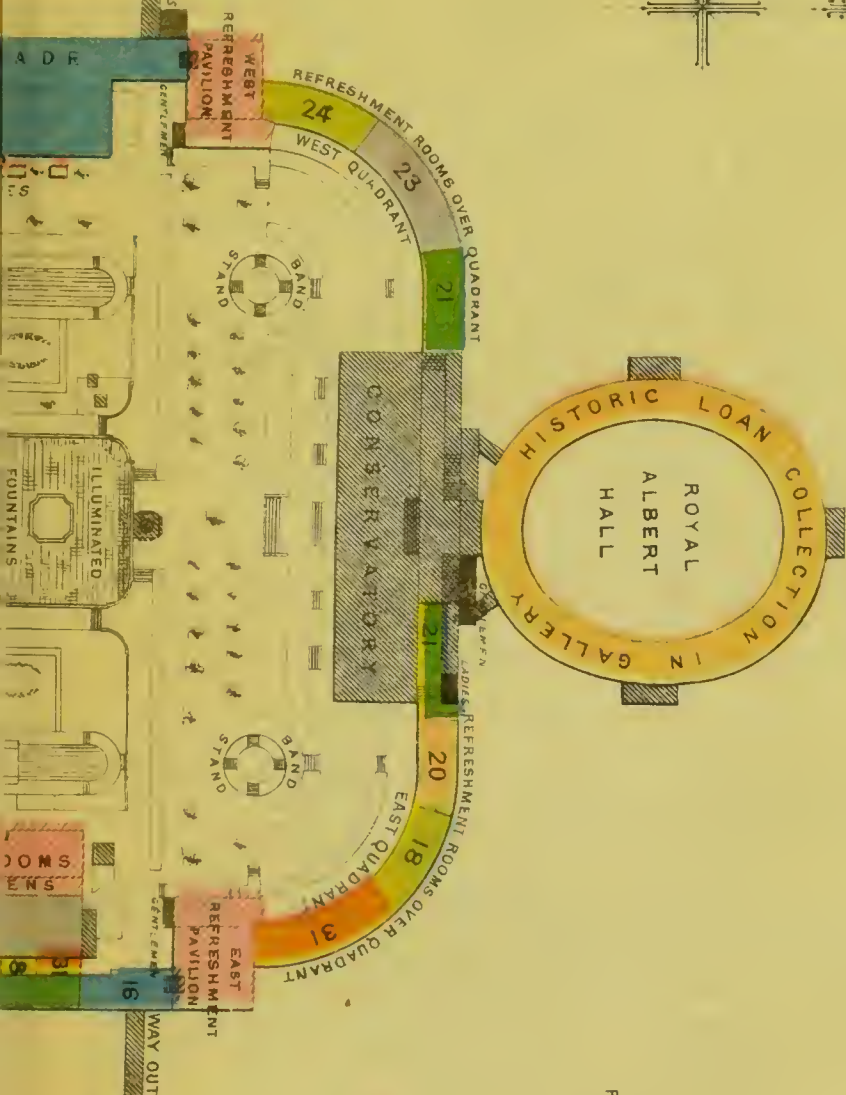
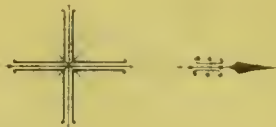
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INTERNATIONAL INVENTIONS EXHIBITION, LONDON, 1885.

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3. Engineering Construction
4. Prime Movers
5. Railway Plant
6. Locomotives & Vehicles
7. Naval Architecture
8. Armaments
9. Textile Fabrics
10. Machine Tools & Machinery
11. Woodworking
12. Elements of Machines
13. Electric Lighting
14. Chemistry
15. Gas & other Illuminants.
16. Fuel Furnaces &c
17. Heat Engines & Steamships
18. Clothing
19. Jewellery
20. Leather &c
21. India Rubber &c
22. Furniture & Home Goods
23. Pottery & Glass
24. Cotton & Linen
25. Paper, Printing & Bookbinding
26. Paper, Printing & Bookbinding
27. Miscellaneous &c



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DIVISION II MUSIC &c

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Information may also be obtained at the Exhibit No. 1307, Section 13, East Arcade.

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CASTINGS,
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with a coating for
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neutralizing the
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STRING FRAMES.



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STRING FRAMES,
cast in one piece
from iron carefully
analysed and test-
ed to stand a ten-
sile strain of 12
tons to the square
inch.

Exhibit No. 3648, Music Gallery.

beyond that the roof line is level, and was chosen as a contrast to the all-prevailing Old London. gable.

At this point (No. 15)—the termination westward of the street—the entrance thereto is masked by one of the galleried fronts of an old London inn. The "Oxford Arms," Warwick Lane, was chosen as a typical specimen; but there are still remaining in Bishopsgate Street, Holborn, and more especially the Borough, several examples of these.

The house beyond (No. 16) was on the west side of Little Moorfields, Finsbury, and was a very fine specimen of plaster work. It was not removed until the commencement of the present century. A low building connects this with two houses (Nos. 17 & 18) possessing considerable interest; they stood at the south corner of Hosier Lane, Smithfield, over against the famous "Pye Corner," where the fearful conflagration of 1666 was arrested, after having laid considerably more than three-fourths of the City in ashes; they were not removed until 1800.

Another gateway here arrests our steps: this was the entrance to the famous Priory of the Holy Trinity, Aldgate, founded by Queen Matilda, and whose Prior, by virtue of his office as representing the Knights Guild, who had made over to this priory their lands and soke, was admitted as one of the Aldermen of London, of the Ward of Portsoken. According to custom, he sat in Court, and rode in scarlet, or such livery as the other aldermen used.

Beyond this (No. 19a) is the gable end of the Hall of the Brotherhood of the Holy Trinity (which is reached by ascending the staircases to the first floor) in Aldersgate Street, near to Little Britain. This Hall has been selected as a typical example of the Hall of a Guild or Livery, of which there were many within the boundaries of the ancient City. The ancient stained glass with a figure of St. Blaise, and several ancient shields which existed in 1611, have been faithfully reproduced.

The house beyond is one of the most remarkable in this street (No. 20), remarkable not only for its extreme richness of decoration, but as being connected with Sir Richard Whittington, famous in song and in story. It was situated four doors from Mark Lane, in Crutched Friars, or Hart Street, up a courtyard, and was described in old leases as Whittington's Palace. Although the house, from its style and ornamentation, could not possibly have been of his time, it is possible that the front only had been ornamented and altered, for in general outline and arrangement it resembled houses of that date; it was richly ornamented with carvings of the armorial bearings of the City Companies, which stamped it as being the house of a remarkable personage, and one whom the City delighted to honour. It was impossible to reproduce the extreme richness of its decoration. The ornamentation has therefore only been painted, the original having been entirely carved and painted and gilt.

The next two houses (No. 21) were drawn by Mr. Gwilt before they were removed; they were situated in Bankside, and are picturesque examples of plaster decoration and open balconies.

The last two houses (Nos. 22 & 23) in this street, on the left before arriving at the gate at which we entered, were also from the Gwilt collection (now in the Gardner) and stood in the High Street, Borough; they were only removed of late years, and were drawn and measured by Mr. Gwilt.

As to actual size the whole of the buildings have only been slightly reduced, but this has been done in proportion, although such reduction is not to a uniform scale, but has been adopted in the different cases to suit the uniformity of the plan and arrangement of the whole. The interiors, it must be recollected, do not in all cases correspond in size with the exteriors.

The foregoing notice is written from particulars furnished by Mr. Geo. H. Birch, the architect, and is not intended to be more than a very brief description of the examples selected to represent "Old London."

The buildings were designed and constructed as bearing upon and connected with the special objects of the International Health Exhibition, 1884, to which the Corporation of the City of London and several of the Livery Companies liberally subscribed.

Upon the transference of the numerous courts and structures which had contained the "exhibits" of the Health Exhibition to the Executive Council of the International Inventions Exhibition, 1885, that body resolved to retain the "street," and to adopt it as a special feature of attraction outside the general scope of a display mainly confined to productions of the last twenty-five years, and in any case not previous to the present century.

The exhibitors to whom the shops and rooms have been allotted this year were consequently selected with the object of providing, as far as was practicable, useful comparisons between ancient and modern handicrafts. The exceptions to this rule are very limited in number.

The plank flooring which covered the roadway last year, time not allowing of Mr. Birch's original idea for a pavement being carried out, has been replaced—under the direction of Mr. Wilson Bennison, architect and surveyor to the Council—by an appropriate pavement in imitation of the old style cobble stones and bricks which greatly adds to the antique appearance of the whole of the surroundings. Although the buildings remain substantially as in last year, improved access and means of communication with other parts of the Exhibition have been established.

The street is now illuminated at night by electricity, thus avoiding the necessity of closing it at dusk, as was the case last year. Both arc and crystal glow lamps are used; of the former kind, five Mackie lamps of 2500-candle-power each are so arranged as to produce the picturesque effect of moonlight in the street and narrow lane and alleys, while the shops and rooms upstairs are lit with 300 incandescent lamps by Crompton & Co., from two dynamos supplied by a 45-horse power Willans' high-speed engine.

**Prince of
Wales'
Pavilion.**

Opposite to the gateway of Old London is the pavilion of H.R.H. the Prince of Wales, which has been completely decorated and furnished by Messrs. Gillow & Co. The entrance-hall and adjoining alcoves are decorated in the Egyptian style, with panels of Musharabyeh woodwork, Oriental embroideries, carpets, metal work, and faience. The drawing-room is of white woodwork, of the Early Style of Louis XIV. The panels are painted on gold in shades of grey and blue, and the chairs are covered in Royal Windsor tapestry. The dining-room is in classical style, with niches and divans in colours. The adjoining room is hung with Italian Mezzari, the floors are all laid in parquet, and covered with Anglo-Persian carpets specially manufactured. Messrs. Gillow & Co. have also kindly provided the furniture and fittings in the room set apart for the accommodation of the Press. The Conservatory is decorated with a very beautiful rockery and fernery, and with a dripping well built by Messrs. Dick Radclyffe & Co. The rockery is lit up by hidden electric lamps. The floor is in mosaic marble.

**South
Central
Gallery.**

Between the Prince's Pavilion and the "Old London" gateway is the entrance to the South Central Gallery. Six of the smaller groups are provided for in this building. On the left-hand side as we go in, at the extreme western end of the Gallery, is the department for furniture and fancy goods. The furniture and decorations of the Royal Pavilion are included in this group, and constitute the most extensive exhibit.

Furniture.

There are also several examples of pieces of furniture ingeniously contrived to meet special cases, also wall and floor coverings and various systems of decoration, together with sundry fancy goods.

Jewelry.

The next group is Jewelry. In this department the largest exhibits are by Messrs. Hancock & Co., and by the Goldsmith's Alliance, who show the manufacture of jewelry, also silver plate and precious stones. The visitor should not fail to inspect the small case of jewelry exhibited by Mr. Guiliano, which contains some of the most artistic specimens of ornaments in gold and precious stones which have ever been brought together. The collection comprises reproductions of Greek, Roman, and Mediæval necklets, bracelets, brooches, &c.; also specimens of open Arabesque work, in gold and enamel, and a method of cutting stones in the natural forms of the crystals. Mr. E. Gray shows some machinery used in the jewellers' trade.

The kindred trade of watches and clocks is next illustrated. Many of the best known watch and clock makers show specimens of beautifully made English time-pieces. There are also a few turret and chiming clocks. **Watches and Clocks.**

Photography is illustrated in the next space. Here are shown numerous examples of the latest forms of photographic apparatus, and of processes, especially those based on the newly discovered properties of gelatine emulsion (see also page 14). Mr. J. Swan, the inventor of the incandescent lamp, which bears his name, is also great in this department, and makes a very interesting show. The majority of visitors will probably be most interested by the processes for printing in ink, from blocks prepared by photography. The results obtained by these methods are extremely beautiful, and all the details of the processes are of great interest; foremost amongst them may be cited the Woodbury and the derived Stannotype processes. **Photography.**

Philosophical instruments and apparatus are shown in the adjoining space. The collection includes microscopes, telescopes, barometers, thermometers, anemometers, spectroscopes, models of mechanism, chemical apparatus, drawing and surveying instruments, calculating machines, and electrical instruments, &c. **Philosophical Instruments.**

The last Group in the South Central Gallery is that of applied chemistry (see also page 11). Here are exhibited the manufactures and industries, based upon the utilisation of the waste products of gas works. One of the most important of these is the manufacture of alizarine, which is exemplified by the British Alizarine Company. There are also exhibited products prepared from paraffin and petroleum, leather tanned by the bichromate process (see also page 12), improvements in the manufacture of sulphate of ammonia and other artificial manures, and various methods of manufacturing bicarbonate of soda (see also page 11). The majority of visitors will probably be astonished at the number of substances manufactured from the waste products of gas works, as set forth in the large chart hung over the eastern doorway of the Gallery. **Chemistry.**

From this end of the Gallery access is obtained to the Austrian Court, which contains exhibits in various groups. The Austrian collection is, however, specially remarkable for the beauty of its pottery, porcelain, and faience. It occupies the old Water Companies Pavilion, and in the beauty and artistic effect of its exhibits offers a striking contrast to the character of the rest of the Exhibition. The principal exhibitor of ceramic ware is the firm of Wahliss, of Vienna. A large portion of the porcelain was made in Bohemia and hand-painted in Vienna. Amongst other things worthy of special attention is a portion of a dinner and tea service, in ivory tint and dark blue and gold, made for the Crown Prince. The centres of the plates are decorated with a monogram and royal crown. There is a good deal of bentwood furniture exhibited, and some beautiful toilet tables inlaid with tiles, also drawing-room cabinets inlaid with plaques. The visitor should not omit to notice the collection of Austrian National Costumes, as shown by coloured photographs. **Austria.**

After inspecting the Austrian Collection the visitor had better leave the Court by the way he came in, and cross over the South Central **East Central Galleries**

into the East Central Gallery, which is given over to Japan, Siam, Switzerland, Germany, and various other foreign countries.

Japan. The Japanese Collection is, as has been usually the case in these exhibitions, of great interest to Europeans, not merely on account of the beautiful specimens of bronzes, porcelain, and other decorative objects shown, but also because of the evidence given of the extremely rapid progress which Japan is making in the arts of Western civilisation. In the Japanese section there are exhibits in twenty-four out of the thirty-four groups into which the Exhibition is divided. It will be a surprise to many visitors to find improvements in modern fire-arms, and complicated telegraph instruments included in the collection. The show of specially Japanese goods, such as silks, porcelaines, bronzes, lacquer work and fans is very representative.

Siam. To the North of Japan is the space allotted to Siam, which is occupied by many curious musical instruments; some of the cases contain beautiful specimens of native textile fabrics. In between the two countries is an interesting case of Indian jewelry, fabrics and costumes. On the Western side are several pianofortes, and a specimen of Mr. Bailie Hamilton's Vocalion, which is a variety of the reed organ, embodying several new improvements. To the North of Siam is the music-room, in which recitals are given at intervals on various instruments shown in the Exhibition. The Western half of the East Central Galleries is allotted to various foreign countries. Amongst the most striking of objects shown in this section are the specimens of Venetian glass shown by the Venice and San Murano Glass and Mosaic Company, the hard glass railway chairs and other objects shown by Mr. F. Siemens of Dresden, and the collection of majolica by Duvigneau and Co., of Magdebourg. The Swiss section contains many beautiful specimens of the watchmaker's craft, and also mathematical instruments.

Music Room.

West Central Galleries. The West Central Galleries are divided between the United States of America and Russia, the Southern and Western portions being reserved for the former country. On entering the gallery by the door leading from the Central Avenue the first exhibit of importance which the visitor comes across is the Multiplex Telegraph System, invented by Mr. Delaney, of Boston. By means of this system are obtained simultaneously over one wire 6 distinct "Morse" circuits with a rapidity of transmission determined only by the expertness of the operator; or 12 similar circuits with a rate of transmission of above 20 words per minute; or 36 messages are transmitted (by the use of the inventor's printing instruments); or 72 printed messages are similarly transmitted at a rate equal to 100 messages during the ordinary business hours of the day. With either the "Morse" or printing instruments these messages may be sent all in one direction, or any number within the limits named in either or both directions over a *single wire* at the same time. Each circuit is independent and private, and it is impossible to "tap" wires and interpret despatches in transit. Facsimile drawings in fineness equal to the ordinary woodcut can be rapidly transmitted over a single wire. The whole system is based upon the principle of having a motor carrying a contact brush over a series of segments at each end of the main line, and both motors working in absolute synchronism by the action of an automatic corrector.

Close by will be found some most useful machines known as type-writers, which are intended as substitutes for the ordinary process of writing with pen and ink. One of these, the "Columbia" type-writer, is the latest machine of this class. It is a model of simplicity and neatness of arrangement, and is extremely portable and comparatively inexpensive. It is claimed that an experienced hand can write by means of it far faster than by hand. Ordinary press copies can be taken, or if preferred any number of copies up to six can be made simultaneously with the original impression by means of carbon paper. The other instrument of this class exhibited is the Hall type-writer, which is also a very excellent machine. Few people have any idea of the extent to which type-writing is adopted in the United States. Thousands of women earn their livelihood by means of these instruments.

The space at the end of this part of the Court is occupied by the Waltham Watch Company, whose display is one of the most interesting in the entire Exhibition. The idea of making watches by machinery is essentially American in its developments. So far back as 1850 a small factory was started at Roxbury, Massachusetts, which was removed four years later to Waltham, and has since grown into the famous establishment with its five acres of floors and over three miles of work-benches, which is represented by the model in the Exhibition. The original stock capital of £40,000 has increased to £800,000, and the number of hands has grown from 75 to 2500. During the last eighteen months half a million of watches have been made, and the working capacity of the factory will soon be 2000 watches a day. In order to employ the hands in the finishing-rooms to advantage, it is necessary to have at least 30,000 watches in progress. For many portions of the work female operatives are employed on account of their greater rapidity and delicacy of manipulation. The women get the same wages as men for doing the same kind and amount of work. The factory is divided into twenty-five departments, each under its own foreman. The majority of the latter have been for about a quarter of a century in the employ of the company. The number of distinct operations required to produce a medium grade of keyless watch was specially calculated for the "Scientific American." It reached the surprising total of 3746—a number which is considerably exceeded for some of the higher grades of watches. The great aim of the company is to secure absolute interchangeability of parts. The various pieces of the work are measured with extreme accuracy; for instance the jewel holes are measured to be two ten-thousandths of an inch larger than the pinions which work in them. The result of this extreme accuracy is that should any part of a watch fail in actual use, a duplicate can be supplied by post on receipt of the name of the part and the number of the movement. All Waltham watches have "going barrels" instead of fusees, which have long since been discarded as useless in every country but England. They have invariably lever escapements and quick trains, by which is meant that the watch beats 18,000 to the hour against 16,200 times, which is the standard in this country. It would be impossible to describe in detail even the principal operations involved in watch making by machinery, but twelve of the most interesting automatic machines may be seen at work in the Exhibition.

They are as follows : a screwing tool, which makes 4000 screws per day. A pinion-turning tool. A dial feet making machine. A tool for drilling and inserting screws into the rims of compensation balances. A lathe for turning the "staffs" of balances at the rate of 500 a day, as against one per hour, which is all that can be accomplished by the most expert hand labour. A pinion leaf polishing machine. A universal lathe for repairing purposes. A pinion leaf cutter. A keyless bevel wheel cutter. A train wheel cutter. An escapement wheel cutter, and a pinion staff polishing tool. It is worthy of note that all the teeth of wheels are cut to a true cycloidal shape, thus ensuring frictionless rolling contact in the wheel work of the watch. The cutters and polishers of these tools are themselves kept true and in perfect order by a machine specially invented to give the exact cycloidal form. The gauging of the strength of hair springs may be seen close to the office of the company. Each spring is tested and provided with a balance wheel of a weight suitable to its strength. Thus one of the most troublesome operations connected with the regulation is accomplished before the watch is put together. In the cases at the wall of the court are to be seen watches of the various grades manufactured by the company, and sold at prices ranging from £2 10s. to £50. Close to the large engine at the North end of the Court are two stands of considerable interest. One is occupied by a weighing and packing machine, which is productive of great economy of labour in large establishments. It is able to pack 18,000 parcels of one pound each per day. The space at the bottom is occupied by the Troy Laundry Machinery Company. The magnificent Corliss engine by Messrs. Hicks, Hargreaves and Co., which drives the machinery in the American Court, should be inspected by all engineers. It is in every way a credit to the Exhibition. It is provided with a small auxiliary or "barring" engine for starting, which throws itself out of gear as soon as the main engine commences to work.

Hicks,
Hargreaves
& Co.'s
Engine.

Russia.

In the Eastern section of this gallery is to be found the Russian collection, which contains many objects of interest. Mr. Woerffel, of St. Petersburg, whose exquisite bronze castings excited so much notice last year, will be again well represented. There is an interesting collection of dress, jewelry and armour from the Caucasus, a magnificent case of furs, and a very good show of pianos, and other musical instruments. Cigarette making machinery is shown at one side of the Court, and freshly made Russian cigarettes can here be purchased. The Russians are celebrated for their enamels on silver, and there is a case exhibited containing many beautiful objects of this description. At the South end of the Russian Court there is a beautiful show by Messrs. Howell and James of Roumanian embroideries.

Music.

From the Russian Court the visitor can easily find his way to the great Central Gallery running East and West, which is reserved for the Musical Exhibition. Here he will find a collection of pianofortes, organs, harmoniums and string and wind instruments, by nearly all the best makers, such as has never before been equalled. To go into all the peculiarities of the different instruments would be impossible, but all novelties in construction and mechanism are open to inspection.

The leading modern improvements in musical instruments have been already briefly described. (See p. 14.)

Before leaving the Central Gallery a few minutes should be spared to inspect the twelve beautiful tile panel decorations put up by Messrs. Doulton on the walls of this part of the Exhibition. Commencing on the left-hand side these panels represent scenes from the lives of the following inventors and musicians: William Caxton, Benjamin Franklin, James Watt, George Stephenson, Henry Purcell, Mozart, Handel, Haydn, Richard Arkwright, Robert Peel, Louis Daguerre and N. Niepce, and Michael Faraday.

It will be found convenient to keep the description of the Musical Sections of the Exhibitions together, and for this reason the important Loan Collection of musical instruments, manuscripts, &c., which is housed in the upper gallery of the Albert Hall, will be here referred to. The easiest means of access to the collection is by the large lift, which plies continuously between the upper and lower galleries of the Hall. It will be found convenient to commence with the three furnished rooms which have been arranged by Mr. George Donaldson, and which are intended to illustrate domestic musical life at three different epochs. The first room, nearest to the great organ, belongs to the early eighteenth century. Both the furniture and the musical instruments should be noted; they include a quartett stand,—a viol d'amore,—a viol da gamba,—and a fine Hitchcock spinet.

The second room belongs to the Tudor epoch. It is hung with splendid pieces of tapestry, and the floor is covered with a Persian carpet, which it would be difficult to match for beauty of design. Both hangings and carpet are at least as old as the Tudor epoch. The musical instruments contained in this room are a theorbo, a chitarrone, an arpanetta, and Queen Elizabeth's own virginal, beautifully decorated, of Italian make, and bearing the Royal Arms. The virginal belongs to the same family of instruments as the spinet and harpsichord,—a family out of which has grown, by a process of continuous development, the modern grand pianoforte.

The third room is in the Louis Seize style. In it are shown a harp of beautiful shape, and a harpsichord belonging to Lord Powerscourt, and painted by Van der Meulen. This instrument formerly belonged to Marie Antoinette.

Passing out of the rooms into the gallery the visitor enters the collection of musical instruments. The first cases contain Mr. George Donaldson's very interesting collection, which includes a guitar that belonged to Louis Seize when Dauphin, and another guitar with fleur-de-lis pegs, which is said to have been the property of David Rizzio. We next come across Mr. Alma Tadema's pianoforte, made by Messrs. Broadwood, in the Byzantine style; the instrument and seat, which is included in the design, are decorated with inlays, ivory carvings, &c. At the far end a silver panel, of great value, is let into the case of the piano. It is by the Neapolitan sculptor, Amendola, and the subject is the drowning of Orpheus. The lower side of the cover contains many autographs of celebrated musicians who have played on this instrument. The back of the seat is painted by Mr. Tadema, as is the little pianino close by, which was also designed by this artist.

Old Violins.

We now come to what, to many musicians, will be the most interesting collection in the gallery, viz., the cases containing the fine old Italian violins, violoncellos, &c. There is a certain interest which attaches itself to this class of instrument which never can belong to any other, and which is based upon the fact that no modern makers have succeeded in developing or changing the type of the best instruments of the Cremona School, which remain, after nearly a century-and-a-half, the very best violins that can be placed in the hands of the modern musician. Collectors will have a rare chance while this Exhibition remains open of making themselves thoroughly acquainted with the peculiarities of the instruments of the old makers, for no such collection has ever before been brought together. It contains no less than 150 fine violins, violoncellos, &c., of which twenty-five are by the celebrated Stradivarius, the prince of violin makers.

English School of Violin Makers.

A special feature has been made of the instruments of the old English makers, who have hitherto been very much neglected, but many of their productions rival, and have been often sold as, fine specimens of Italian make. Amongst the English makers may be mentioned Bernard Fendt, of whose make a splendid violin is shown,—Banks—Forster—Duke—Wamsley—Betts, and five generations of Hills, one of whom of the fifth generation has arranged the present collection. An interesting violin of English make, by Urquhart, is shown. It was made in 1666, the year of the great fire of London.

Brescian School.

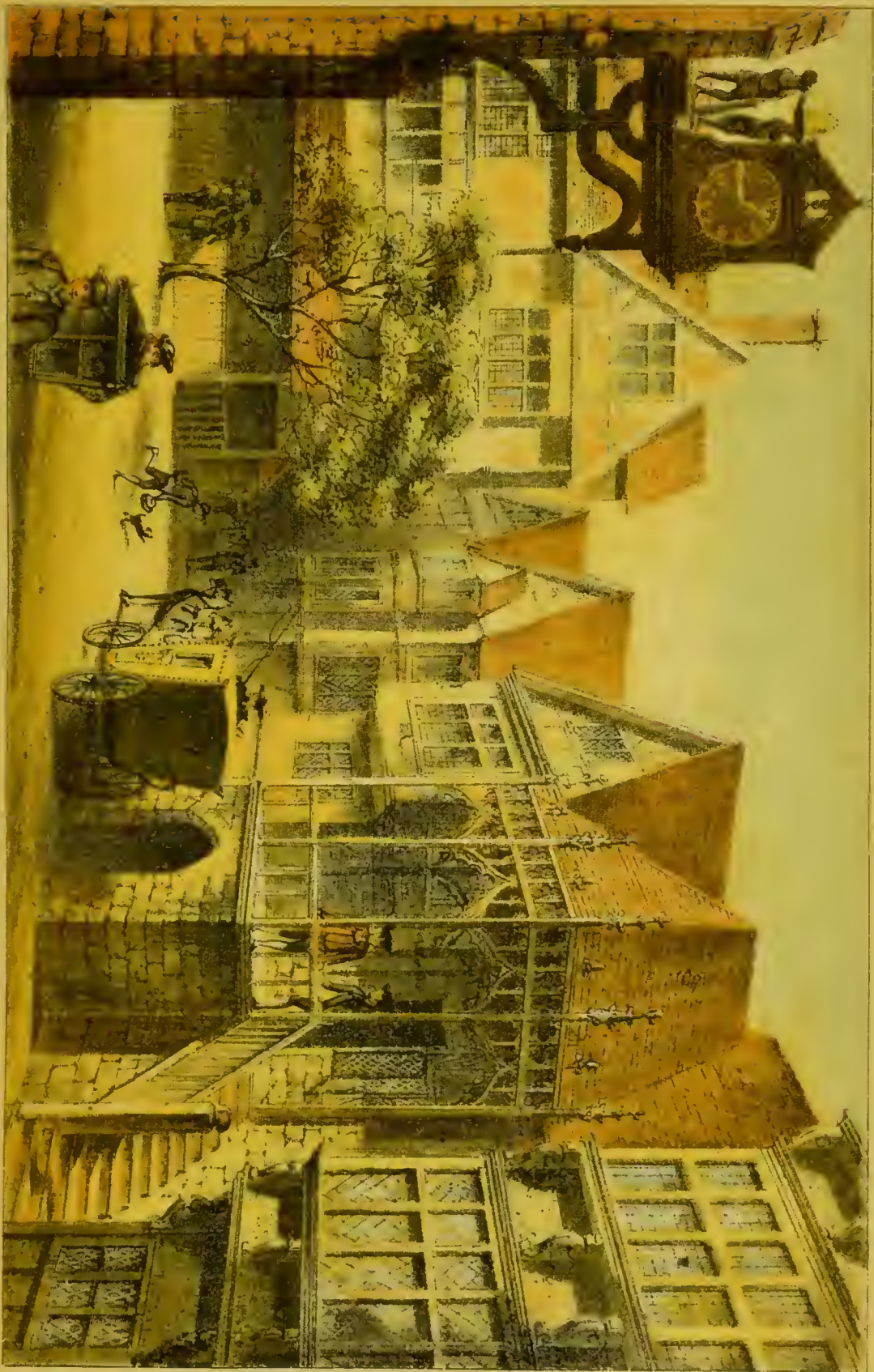
The Italian collection is arranged, as far as possible, chronologically. The first cases contain instruments by the famous Brescian makers, Gaspar di Salo, Maggini, and Zannetto, who lived as far back as the year 1500. These makers may be called the fathers of modern violin making. The instruments shown are nearly all tenors, which are of very fine tone. It is a curious fact that the violins by these makers are not nearly so good as their tenors.

Amati School.

The next cases contain specimens of the make of the Amati school. The greatest of the Amati family is Nicholas, and one of his instruments is shown which is the finest in existence. It is called the Alard, date 1645. There is also a very fine specimen of Antonius and Hieronymus Amati, and several by Francesco and Joannes Baptista Ruggerius, both pupils of this famous family. There are also four tenor Amatis shown, one of which belongs to the Queen. Three of these instruments have been reduced from their original size in recent times. The fourth, which will be easily recognised, retains its original size: it is by Antonius and Hieronymus. It is almost too large to be played, except between the legs, after the manner of a violoncello.

Violins by Stradivarius and Guarnerius.

We next come to the cream of the collection, the cases containing instruments by Stradivarius and Guarnerius. So highly valued are these instruments, both by collectors and violinists, that a good violin in the best style of either of these makers, and in perfect preservation, will fetch the price of a thousand guineas. The first case contains violins by Stradivarius, in excellent preservation, though not perhaps in the very best model of this famous maker. The second case contains six instruments by Stradivarius, which it would be difficult to match. The latest violin, dated 1732, which in workmanship is as good as anything he ever turned out, and is probably the best instrument known of its



THE "OLD LONDON STREET"



date, was made when the master had reached the age of eighty-three years. The model is perhaps a little fuller than what is now reckoned as his best type. Each of these instruments would fetch a thousand guineas. There are not more than twenty violas by Stradivarius in existence; so this Exhibition is fortunate in showing two, and both perfect specimens. Their dates of 1690 and 1721. The instruments in this case show the three epochs of Stradivarius, viz. :—1689, 1690—1711, 1716—and 1721, 1732; the two of his grand period 1711, 1716, are the finest in the entire collection. There is a third case containing several interesting instruments by this maker, and then we come to the collection of violins by the celebrated Guarnerius family, the greatest of whom, Joseph Guarnerius del Jesu, was the only equal of Stradivarius. There are seven fine violins by this maker shown, which are worth from £700 to £800 each.

Then comes a case belonging to the Venetian school, of whom Peter Guarnerius, Sanctus Seraphino, and Montagnana were the most famous makers. The best specimens of their make fetch from £150 to £200 a-piece. The handsome Sanctus Seraphino violoncello is known as the "beauty."

Following on, the next case is chiefly remarkable for a violoncello made for Charles IX. of France, by Andreas Amati. Then comes a small collection of instruments of the Roman school by Techler and Guadagnini, and next a case containing specimens of the Dutch and German schools, including two unique Steiners and a violoncello by Rombouts, of the Hague, date 1720.

The last case, which will be particularly referred to, contains two violoncellos by Stradivarius, one of which belonged to the husband of the singer Mora, who evidently took but little care of his instrument, which in model, wood, and workmanship is a beautiful specimen. The other instrument was made for a Corfu nobleman, by whose family it was kept, wrapped up in cotton wool, for a century; hence its perfect state of preservation. In this case are also contained two Bergonzi violins and a cello.

After passing the violins we come to the collection of spinets, harpsichords, old wind instruments, &c., which is undoubtedly the most interesting and complete ever brought together. We first come across the collection sent by the Conservatoire of Music of Brussels, and which is so complete that it may almost be said to be a museum in itself. It fills several cases, which contain, amongst other things, a fine Flemish spinet—the Patavini spinet of the year 1550,—exact copies of the Roman Cornu and Lituus—a remarkably fine specimen of an early upright grand pianoforte by Frederici of Gera, dated 1745,—and a complete set of 16th century cromornes, the only set in existence: this instrument is almost unknown, even by name, except for the Cremona stop on the organ, which takes its name from it. This collection contains also a positive and portative organ, or Regal; only two specimens of this instrument are known to exist. With these latter is exhibited M. Victor Mahillon's Shudi harpsichord, which once belonged to the Empress Marie Theresa.

Close by is exhibited a claviorganum, a once not uncommon instrument, with two rows of keys, which is a compound of organ and

Loan Collection.

harpsichord, and was made in London in 1745. The next remarkable objects are, a double spinet by Hans Ruckers, belonging to Messrs. Chappell, and the Maidstone clavichord, which is said to have belonged to Handel. Close by is a curious-looking piano of anonymous make, which belonged to the Irish Lady Morgan. In style and inlaying it resembles the cabinets of the epoch. We next pass a Broadwood grand piano, made for Mr. W. Graham, and painted by Mr. Burne Jones with the Story of Orpheus and an Allegory of the Earth and her Children.

In the centre of the Gallery are two old Highland harps, resembling the famous one in the museum of Trinity College, Dublin. They are of the fifteenth century. One belonged to Mary Queen of Scots, and was given by her to Beatrix Gardyne of Banchory. The other, which is called the Lamont harp, was for a long time in the family of the Robertsons of Lude. They are lent by Mr. Stewart of Dalguire.

We now come to an interesting collection lent by the Queen, and which contains an Erard piano with old French paintings and a Ruckers harpsichord from Windsor Castle, which Mr. A. J. Hipkins, who is a great authority on musical instruments, and has had an important share in forming and arranging this collection, considers to have been Handel's, and the one described in his will; also a case containing the original scores, in Handel's own handwriting, of the 'Messiah,' 'Israel in Egypt,' and other works.

Musical Manuscripts, &c.

The remainder of this gallery is given up to the splendid collection of ancient musical manuscripts, treatises, scores and old printed musical books, which is of great interest to antiquarians and musicians. It would be impossible to describe in detail all the interesting objects contained in this section, but a few of them may be mentioned, such as the Mainz Psalter of the year 1457, lent by Lord Spencer, which is the first book printed with music inserted by hand, and which is insured for £10,000. A curiosity of composition is Tallis' forty part song, the MS. score of which is shown. Another interesting relic is a Gloria written in 1502 by Dr. Fayrfax for his degree. In one case are contained autographs of Beethoven, Bach, Mozart, Haydn, Purcell, Wagner, Schuman, Cherubini, Gounod, and other famous composers. The musical notation of early times is illustrated by a manuscript of the eleventh century, written in a series of symbols called Neumes. The collection contains also a set of the musical treatises of Franchinus Gafforius, printed between 1480 and 1497 and lent by Lord Spencer, Mr. A. Lyttleton, and the Trustees of Anderson's College, Glasgow. The earliest example of printed music in England is shown by a copy of Higden's 'Polychronicon,' printed by Wynkyn de Worde at Westminster in 1493. There are four treatises on the organ, and three very early works on dancing by Curoso and Negri; also a splendid manuscript lent by Lord Ashburnham; a ballad written to English words on the death of Cardinal Wolsey, and a Mass which was probably written for the coronation of Henry VIII.

No. of Section.	Name of Section.	Exhibitor.	Description of Dynamo.	Description of Lamps.					Description of Motive Power.	
				Name of Lamp.	Arc.		Glow.			
					No.	C. P.	No.	C. P. V.		
1	South Promenade . . .	R. E. Crompton & Co., Mansion House Bldgs., 4 Queen Victoria St.	1 Crompton Bûrgin .	Crompton	10	3000	...	...	"Tower" Spherical Engine	6 on 3 masts, and 4 at entrance. Lamps in series.
2	South Court (a) (b) Entrance Vestibule (c)	Edison Swan El. Lt. Co., 57 Holborn Viaduct.	Edison 2 Edison Hopkinson .	Swan Edison Swan Bernstein . . . .	... ... ... ...	... ... ... ...	... 80 400 10-46 50-46	... ... ... ...	Davey, Paxman, & Co. Engines. Nos. 1, 2, & 3.	Fittings by B. Verity. Lamps in parallel.
3	Dining Rooms . . .	Paterson & Cooper, 76 Little Britain, E.C.	1 Phoenix, 36 unit 1 " 12 " 1 " 10 " 1 " 14 " 2 W 11 Siemens 2 D Exciters	Swan . . . . .	...	...	...	1080	D. P. & Co. Engines. No. & .	Lamps 2 in series.
4	Middle Court . . .	Siemens Bros., 12 Queen Anne's Gate, Westminster.	2 W 11 Siemens 2 D Exciters	Swan . . . . .	...	...	...	1080	D. P. & Co. Engines. No. & .	Lamps 4 in series.
5	North Court . . .	Anglo-American Brush El. Co., 112 Belvedere Road, Lambeth.	2 F 3 Victoria . .	Victoria . . . .	...	...	...	750	Kilson Parson High Speed Engines.	Lamps 2 in series.
6	Water Pavillon . . .	Golden & Trotter, 2 Victoria Mansions, Westminster.	2 G. T.	W. & R. . . . .	...	...	...	300	D. P. & Co. Engines. No. & .	Lamps in parallel.
7	H.R.H. Pavillon. Conservatory (b)	Elwell Parker, Commercial Road Works, Wolsingham.	2 E. P.	Swan W. & R. W. & R. . . . .	... ... ...	... ... ...	... ... ...	100 50 80	Elwell Parker High Speed Engine.	Worked in parallel, with E. P. storage cells.
8	Old London Street . .	S. J. Mackie, Turk's Head Yard, Turnmill Street.	1 B Gramme . . . 2 A Grammes . .	Swan . . . . .	... ...	3900 ...	... ...	... 30	D. P. & Co. Engines. No. & .	Arcs in series. Glow lamps in parallel.
9	Old London	R. E. Crompton & Co., Mansion House Bldgs., 4 Queen Victoria St.	2 Crompton Bûrgin .	Woodhouse & Rawson	...	...	...	300	"Williams & Robinson" Engine.	Lamps 2 in series. Fittings by B. Verity.
10	Engine Shed	J. D. F. Andrews & Co., Woodside Electric Works, Woodside Rd., Glasgow, N.B.	2 Andrews	Andrews	20	700	...	...	D. P. & Co. Engines . . .	2 series of 10 lamps.
11	S. & P.'s Refreshment Bar and Grill Room.	Clarke, Chapman & Co., Victoria Works, Gateshead-on-Tyne.	2 C. C.	Gérard . . . . .	...	...	...	30	C. C. Turbine Engine . .	2 lamps in series.
12	Queen's Gate Annexe .	Anglo-American Brush El. Co., 112 Belvedere Road, Lambeth, S.E.	2 Brush	Brush-Sellon . . .	24	3000	...	...	D. P. & Co. Engine . . .	2 circuits of 12 lamps each.
13	South Central Gallery .	Jablochhoff El. Lt. Co., 36 Albert Embankment, Lambeth.	4 Jablochhoff Gramme	Jablochhoff . . .	60	350	...	...	D. P. & Co. Engine . . .	Lamps arranged in 12 circuits of 5 each.
14	West Arcade	Gûlcher El. Lt. Co., Battersea Foundry, S.W.	2 Gûlcher	Swan . . . . .	...	...	...	760	Coalbrookdale High Speed Engine.	Lamps in parallel.
15	East Arcade (a) Concert Room (b) B. Bar (c)	Gouland & Gibbs, 18 Warwick Street, Regent Street.	... ... ...	Varley Maixim Swan	24	200 ... ...	... ... ...	... 50 80	D. P. & Co.	Lamps by induction bob- bins from one circuit.

No. of Section.	Name of Section.	Exhibitor.	Description of Dynamo.	Description of Lamps.				Description of Motive Power.		
				Name of Lamp.	Arc.		Glow.			
					No.	C. P.				No.	C. P. V.
16	West Gallery . . .	Pilsen Joel El. Lt. Co., St. Stephen's Chambers, Telegraph Street, Moorgate Street.	4 Schlickert . . .	Pilsen	42	700	...	...	D. P. & Co. Engines . . .	Lamps, 3 circuits of 14 each.
17	West Annexe . . .	Paterson & Cooper, 76 Little Britain.	2 Phoenix	J. F.	21	700	...	...	D. P. & Co. Engines . . .	Lamps, 2 circuits of 12 each.
18	West Central Gallery . . .	Cordner Allen & Co., 20 Bucklersbury.	4 G. T. (Halifax) . . .	S. N. & R.	30	1000	...	20-50	D. P. & Co. Engines . . .	Lamps on 3 wire system 10 arcs, 20 glows, parallel on each machine.
19	East Central Gallery . . .	Maxim Weston El. Co., 32 Queen Victoria St.	2 Weston	Weston	25	2000	...	...	D. P. & Co. Engines.	Lamps all in parallel.
20	Central Gallery . . .	Gulcher El. Lt. Co., Battersea Foundry.	3 Gulcher	Gulcher	50	1000	...	...	Westinghouse High Speed Engines.	Do. with "arcs."
21	Chinese Restaurant . . .	Gulcher El. Lt. Co., Battersea Foundry.	(As above)	Swan . . . . .	...	...	...	16-45	As above	In series.
22	Mast Light	Goulden & Trotter, 2 Victoria Mansions, Westminster.	1 Hochhausen	Hochhausen	6	3000	...	...	D. P. & Co. Engine . . .	
23	Fountain	Siemens Bros., 12 Queen Anne's Gate, Westminster.	1 Siemens Ditto. . . . .	...	12	...	...	...	D. P. & Co. Engines . . .	Used for the illumination of the fountains, being burnt in parallel arc.
24	East Gallery	Laing, Wharton & Down, 8 & 9 Holborn Viaduct.	1 Thompson Houston . . .	Thompson Houston . . .	45	1000	...	...	D. P. & Co. Engines . . .	In series.
25	East Annexe A	E. Fox, 4 Orchard Buildings, Acton Street, Kingsland Road, E.	1 Oppermann	Harting-Hartmann . . .	6	1000	...	...	Armington Series High Speed Engine.	In series.
26	West Quadrant	J. E. Statter, 37 High Street, Chelmsford.	1 Birglin	Statter	6	1000	...	...	D. P. & Co.	In series.
27	East Quadrant Conservatory	Clark & Co., 411 Brixton Road.	2 Phoenix	Clark-Bronau	16	1000	...	...	D. P. & Co.	In 2 series of 8 each.
28	Dual Dining Rooms (a) Austrian Court (b) Entrance Vestibule (c) Cascades (d) Club Dining Rooms . . .	Siemens Bros., 12 Queen Anne's Gate, Westminster, S.W.	1 Siemens D	Siemens	4	6500	...	...	D. P. & Co.	In parallel.
29	Press Rooms and Fitzinger's Coffee Stall	Electric Sun Lamp Co., 6 Riding House Street, Regent Street, W.	2 Clero Bureau	"Sun"	32	1200	...	...	D. P. & Co.	On 4 circuits of 8 each.
30	S. & P.'s Temperance Refreshment Rooms	Woodhouse & Rawson, 11 Queen Victoria St.	1 Elwell Parker	W. & R. . . . .	...	...	300	20-80	D. P. & Co. Engines . . .	Lamps in parallel.
31	Queen's Gate Entrance . . .	W. H. Allen & Co., York St. El. Works, York Road, Lambeth.	1 Victoria	W. & R. . . . .	...	...	...	16-50	"Tower" Engine.	Lamps 2 in series.
32	S. & P. Tea Rooms . . .	Consolidated El. Co., 67a & 68a Cow Cross Street, E.C.	1 Kapp	Consolidated . . . . .	...	...	100	5-72	Allen High Speed Engine . . .	Do. 4
33	S. & P. Cellars	Peakin, Parker & Co. Mather & Platt . . .	1 Victoria (?)	Siemens . . . . .	...	...	250	16-60	Do. P. & Co. Engines . . .	In parallel B. T. K. system from accumulators.
34	Subway	Hathorn, Davey & Co. Property of Commission of Exhibition.	1 Siemens	Swan	4	1500	...	...	M. & P. High Speed Engine	Lamps in series.
35			1 Mather & Platt	Swan . . . . .	...	...	150	16-80	"Dacey" Motors . . .	Lamps in parallel.
			2 A Grammes	Swan . . . . .	...	...	80	10-45	"Willans" Engine, "Obriek" Boiler.	Lamps in parallel. (Machinery in Duplicate.)
			2 Elwell Parker	Swan . . . . .	...	...	50	16-80		

VI.—THE ELECTRIC LIGHT—THE GARDENS, AND MUSICAL ARRANGEMENTS.

ELECTRIC LIGHTING OF BUILDINGS AND GROUNDS—MACHINERY FOR
ELECTRIC LIGHTING—THE GARDENS—THE MUSICAL ARRANGEMENTS—
TRAMWAYS.

ONE of the most remarkable features of this Exhibition is the thoroughness with which the electric lighting arrangements have been carried out. It may safely be stated that nothing on so large or so representative a scale has ever before been brought together. As a comparison it may be mentioned that whereas in 1883 there were 252 arc and 2629 incandescent lamps, this year there will be 464 arcs and 5530 incandescent lamps, used in and about the buildings, in addition to the 18,000 incandescent lamps used in the gardens as a substitute for the small oil lamps hitherto employed for the illuminations. The whole of the current required for the gardens is supplied by Messrs. Siemens Brothers, but the lighting in the buildings is distributed amongst several firms as set forth in the annexed list, taken from the Official Catalogue (see pages 59, 60). The whole of the power required to light the buildings is supplied by Messrs. Davey, Paxman, & Co., whose engine-house is situated between "Old London" and the South Gallery. This firm supplied the engine and boiler power necessary for working the whole of the vast system of electric lighting throughout the late Health and Fisheries Exhibitions. At the Fisheries Exhibition about 1000-HP. was employed, at the Health Exhibition about 1300-HP., and at the present Exhibition 2300-HP. in steam is provided for. The power is greater than that of any display which has yet taken place. The steam engines provided for this purpose are five in number. The two largest engines are capable of developing 750-HP. Nos. 1 and 2 engines are of the coupled horizontal type (same as fixed for driving the electric light at the South Kensington Museum), and provided with Paxman's Patent Automatic Cut-off Gear, worked direct from the governors, so as to ensure very steady and even running. The advantage of this system is that only just sufficient steam required for the duty is admitted to the cylinder at each stroke of the piston. This is one of the very few automatic arrangements which work with regularity and certainty. The cylinders are steam jacketed. It may be mentioned that one of the large driving bands on one of the engines suddenly broke when the engine was transmitting about 350-HP., but the excellence of the automatic gear—even in this extreme case—prevented the engine from over-running. No. 3 engine is of the compound receiver type, indicating 200-HP. It is fitted with Paxman's Automatic Gear as above described. The cranks are at right angles, and accurately balanced. With condensers and good generators, this engine will work with less than 2 lbs. of coal per indicated horse-power per hour, and run very smoothly and with great steadiness. No. 4 engine is of the semi-fixed compound type, of 140 indicated HP., and is precisely the

Electric
Lighting
of Build-
ings and
Grounds.

Machinery
for Elec-
tric Light-
ing.

**Machinery
for Elec-
tric Light-
ing.**

same as No. 3 above described, but with locomotive boiler placed above the engine. At the Health Exhibition this engine, although without condenser, ran constantly with $2\frac{1}{4}$ lbs. of fuel per indicated horse-power per hour. No. 5 engine is a double cylinder semi-fixed steam boiler. A battery of eight large boilers, of the locomotive type, is fixed between the two large coupled engines for supplying them, as also some high speed engines, with steam. There is also a second battery of six boilers on the west side. The whole of these are made to work at 100-lbs. steam pressure. The fire-boxes are of mild steel. Altogether nearly 2300-HP. in boilers are provided for. Receivers, 16-in. diameter, have been placed along the top of the two batteries of boilers.

**The
Gardens.**

The Gardens, with their innumerable electric lights, are a spectacle which has never yet been rivalled, and will undoubtedly prove to be the great popular attraction to the Exhibition.

The principal lines of the Conservatory, band-stands, Albert Statue quadrants, and the buildings on the east and west sides of the gardens are picked out with lines of light, as also are the chief features of the garden, such as the balustrading, terrace lines and flower beds, while the trees and shrubs are profusely sprinkled with richly-coloured lamps. The whole of this work has been undertaken by Messrs. Siemens Brothers, under the direction of Sir Francis Bolton. The number of incandescent lamps used is about 10,000, and the necessary current is derived from three Siemens' dynamos coupled parallel, each of which is capable of producing a current of 450 ampères at a potential of 250 volts. This being the largest output ever obtained from a single machine. The dynamos are each directly driven by a Goodfellow and Matthews 6 cylinder compound engine of 200 indicated horse-power.

**South
Parade.**

In addition to the Upper Gardens, many other portions of the grounds are well worthy of a visit. The Central Avenue is beautifully planted with rhododendrons. The garden adjoining the North Court of the South Gallery is well laid out, and contains two out-door cafés, which are much frequented. In the bit of ground to the north of Old London, Mr. Lockhart has a very popular cocoa and coffee house. To the south of the Great Southern Gallery is a long stretch of ground occupied by many interesting exhibits. Towards the eastern end Mr. Williamson has an oyster bar. Close by are many samples of green-houses, conservatories, and methods of glazing without putty. A full-sized model in wood of a cast-steel stern-post with brackets for twin screws, all in one piece, is a splendid sample of the work which can now be executed by Messrs. Jessop. (See also p. 33.)

**Tram-
ways.**

In this part of the grounds are also to be seen two very interesting tramways, in one of which the car is driven by compressed air, and in the other by electricity. The former is exhibited by the British Mékarski Improved Air Engines Co., Limited. A short description of the method of working the car may be found interesting.

**Mékar-
ski's Air
Engine.**

By means of engines and pumps atmospheric air is compressed into reservoirs to 450 lbs. on the square inch. From these the air is, when the car is coupled up to the charging-pipes, allowed to pass into smaller reservoirs, which are carried underneath the car-body. When these are charged with atmospheric air to the necessary pressure, the charging-pipes are disconnected, and the car is ready to commence its

journey. To the driving-wheels of the car ordinary working cylinders of $5\frac{1}{4}$ inches diameter by 10 inches stroke are connected, and through these cylinders the compressed air from the reservoirs is used. The principal feature of the system is that the air in passing from the reservoirs to the cylinders bubbles through boiling water, and steam of 60 lbs. pressure on the square inch, contained in a vessel called a "hot-pot"—this vessel being charged at the pumping station during the time occupied in filling the car reservoirs with compressed air. The advantages claimed in thus using the air are that the heat which the air takes up in passing through the hot water, not only causes the air to expand, but prevents the formation of snow in the cylinders and at the exhaust. The moisture also picked up by the air in its passage through the water acts as a lubricant for the slide valves and pistons.

The working pressure varies from 120 lbs. down to 50 lbs. on the square inch, the variation being regulated by a valve of peculiar construction. One of the "hot-pots," with its regulating valve upon it, has been placed at each end of the car, and means for ingress and egress of passengers has been provided; so that when the end of the journey is reached, the driver takes his reversing handle, and the wheel of the regulating valve, to the opposite end of the car with him, and the conductor changes ends as in the ordinary horse-car.

Among the many requirements of the Board of Trade is one that there shall be provided upon the car a governor, which shall, when the car exceeds a speed of 10 miles an hour, not only cut off the steam, or rather the air, from the engines working it, but shall put on the brakes. An apparatus fulfilling these requirements has been fitted, and it works most satisfactorily.

The electric tramcar is one of ten now being constructed for the Electric Tramway Company of Blackpool. It is worked in the following manner. An underground channel is constructed in the centre of the track, having a narrow slit or opening in its surface, so that communication can be made between the electric motor on the car and electric conductors within the channel. Two conductors are employed; first, that they may be hidden under either side of the surface, and so be protected from injury by any substance falling through the slit in the surface of the channel; and secondly, to make it possible to deal with points, loops, and crossings. The current returns by means of the rails, which are electrically connected one with the other. Communication is made with the cars by means of a collector, which runs upon the copper conductors within the channel. Insulated copper bands, protected by steel plates, pass through the slit and are attached by a flexible metallic cord to an electrical terminal underneath the car, so that when the car moves the collector is drawn along with sufficient force to clear away any ordinary obstruction; but, should an absolute block occur, then a special clip releases the collector and a breakage is avoided. From the terminal underneath the car the current passes to the switch-box, when the quantity and direction of the electricity passing to the motor is regulated, and thereby the speed and direction of the car is controlled. From the motor the current passes by way of adjustable clips to the axles and by them through the wheels to the rails and back to the station where the electricity is generated.

Electric
Tramcar.

The musical arrangements have been very carefully thought out, and a great treat has been provided for Londoners in Strauss' famous orchestra of 45 performers, which has been specially engaged to come from Vienna and to remain in London for two months, from June 3rd. The full band and trumpet corps of the Pomeranian (Blücher) Hussars will also, by special permission of the Emperor of Germany, visit the Exhibition during the month of June. In addition to the above, the bands of the three Guards' Regiments, of the two Life Guards and Royal Horse Guards,—the Royal Artillery,—the Horse Artillery,—the Engineers—Marines, and the Royal Irish Constabulary will give concerts during the season. The bands will perform twice daily, viz. in the afternoon and evening; during fine weather in the grounds, and when wet in the Albert Hall.

The electrically illuminated fountains this year have been considerably augmented and improved. The effects produced by the various coloured beams of powerful arc lamps, thrown upon the jets and sprays of the fountain are produced by an elaborate combination of appliances, which are well worth a short description. The whole arrangement is controlled from a small room in the clock-tower, commanding a bird's eye view of the grounds. On a small bench beneath the window is an instrument resembling the key-board of an harmonium, having 3 tiers of keys for giving by means of electrical connections the necessary directions to the men stationed in a chamber constructed in the basin immediately under the principal fountain jets. A second key-board furnishes the means of automatically controlling the lights in the various parts of the grounds, which can be put on or off, raised or lowered, at the will of the operator. Several improvements have been made since last year in the fountain basin. A second wall has been built round the centre island above the outer water level; this produces a cascade, the water from the centre fountain jets flowing over it from the higher to the lower level. Seven small islands have also been constructed in the basin, each surmounted by ornamental rockwork and a fountain jet. These islands each contain a powerful arc lamp, and various glass slides, so arranged as to throw their beams upon the centre fountains; the whole being worked by an ingenious arrangement from the centre island. On the west side of the fountain is a small rustic house, from which access to the centre island is obtained by means of a subway. The interior of the island contains a perfect labyrinth of water mains with their various valves and five large arc lamps, so arranged as to throw their beams vertically through glasses let into the roof immediately under the five principal jets, each lamp being provided with five glass slides of various colours, which can be instantly interposed between the lamp and the glass in the roof. Ranged along one side are the various indicators worked from the clock-tower; a man seated in front of these reads off the various signals and passes the word to the men operating the valves, lamps and coloured glasses. Eight men are necessary in order to read the signals, attend to the valves, and the five lamps, to shift the colours, to work the communications with the seven small island lamps, and to reply to the telephone.

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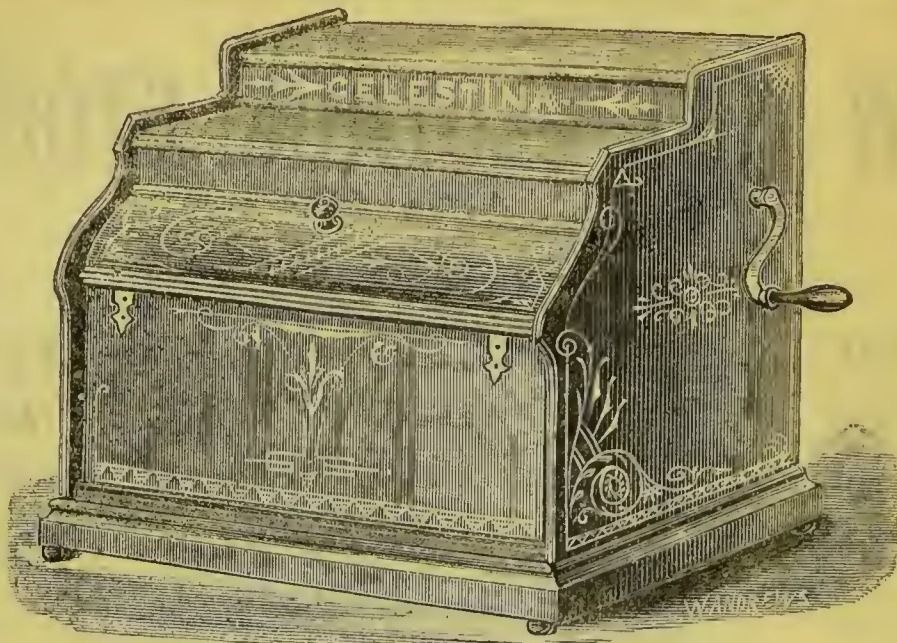
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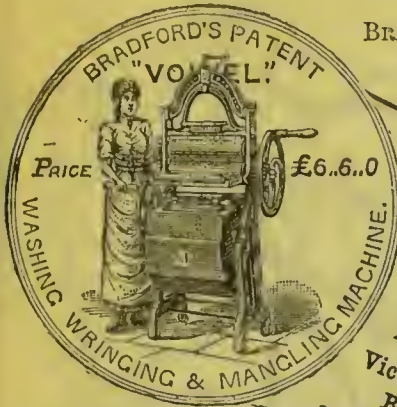
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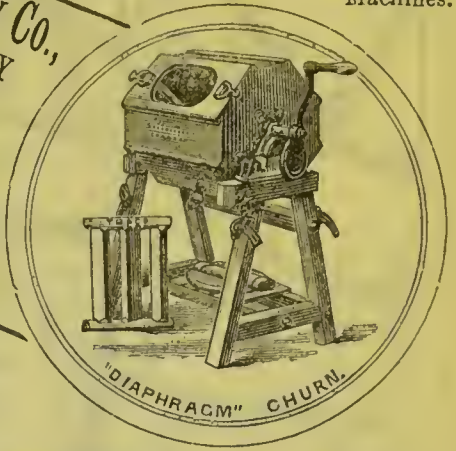
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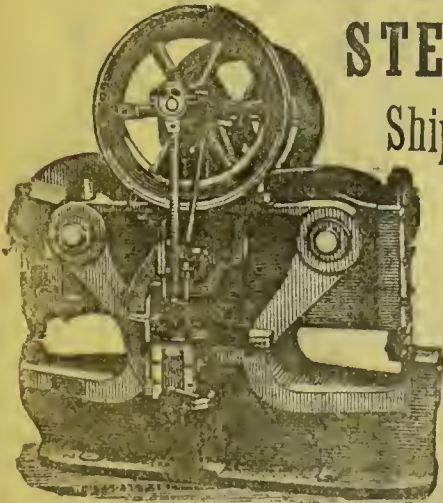
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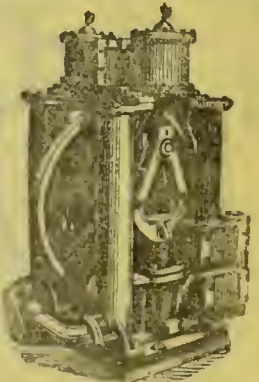
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This is a detailed black and white map of London and its surrounding areas, showing a dense network of roads and railways. The map includes numerous place names such as Harrow, Acton, Ealing, and various districts within London. The railway lines are represented by thick, dark lines, and the roads by thinner lines. The map is oriented with North at the top.

Key locations and features include:

- Northwest:** Harrow, Acton, Ealing, Uxbridge, and the Great Western Railway line.
- West:** Willesden, Willesden Junction, and the Metropolitan Railway line.
- Central:** A dense network of roads and railways connecting various districts, including the City of London, Westminster, and the Strand.
- East:** Finsbury, Islington, and the Great Northern Railway line.
- South:** Putney, Wandsworth, and the South Western Railway line.
- Southwest:** Bournemouth, Poole, and the Dorset Railway line.

The map is a historical representation, likely from the early 20th century, given the style of the lines and the inclusion of specific railway lines and stations.

From any station within thirty miles of London (with very few exceptions) visitors can obtain tickets which include the journey by the shortest available route, the use of the Subway from South Kensington Station, and admission to the Exhibition. The lines of all the leading railway companies are connected by interchange stations, subways, or the underground system with the Metropolitan, and Metropolitan District Inner Circle Line.

The following Table gives full information to country visitors arriving in London by the principal railway lines as to the shortest method of reaching the Exhibition, *viâ* the Inner Circle Line.

Arriving from Stations on the	At	Proceed to South Kensington from the following Stations.	Time on journey by Inner Circle or Through Railway to South Kensington.	MINUTES.
Great Eastern	Liverpool Street	Bishopsgate (Inner Circle)		37
North London	Broad Street	{ A few minutes' walk to Mark Lanc (Inner Circle) }		28
Tilbury and Southend	Fenchurch Street	{ Station, thence by Train		7
Chatham and Dover	{ Victoria	Victoria (Inner Circle, by Subway)		17
Brighton and South Coast	{ Ludgate Hill or Holborn	Blackfriars (Inner Circle) Station		7
South Eastern	{ Victoria	Victoria (Inner Circle, by Subway)		26
South Western (<i>Loop Line</i>)	{ London Bridge	Monument (Inner Circle)		13
Ditto (<i>Main Line</i>)	{ Charing Cross	Charing Cross (Inner Circle)		24
North Western	{ Cannon Street	Cannon Street (Inner Circle, by Subway)		28
	{ London Bridge	Monument (Inner Circle)		14 and 12
	{ Richmond	Richmond		24
	{ Waterloo, thence by 2d. 'bus	Charing Cross or Westminster Bridge (Inner Circle)		24
	{ Euston	Gower Street (Inner Circle)		15
	{ Willesden Junction	Wilkesden Junction		28
	{ Paddington	Praed Street (Inner Circle)		26
	{ Ealing	Ealing		
	{ Westbourne Park	Westbourne Park		
Great Western (<i>Main Line</i>)	{ Through Trains direct to South Kensington from Windsor and intermediate Stations, <i>viâ</i> Ealing.			
Ditto (<i>Windsor Line</i>)	St. Pancras			
Midland	King's Cross	King's Cross (Inner Circle)		27
Great Northern	Westminster Pier	Westminster Bridge Station		12
All Down-River Piers				

CAB FARES

TO OR FROM THE

EXHIBITION ROAD ENTRANCE.

	M.	YDS		M.	YDS
Alpha Road ..Alpha Place, St. John's Wood	2	549	Hammersmith.....North End, Edith Road	2	278
Baker Street	2	326	Hanover Square	2	428
Bank of England	4	260	Harley Street Devonshire Street, Marylebone	2	772
Basinhall Street	4	289	Herne Hill	5	1523
Battersea Bridge.....	1	850	Holborn	2	1500
Battersea ...St. Mary's Church, Church Road	2	51	Holborn Circus	3	784
Battersea Park .. Chelsea Suspension Bridge	1	1597			
Baywater Queen's Road, Porehester Gardens	1	1504	HOSPITALS:—		
Bedford Square	2	1444	Bethlehem	3	608
Belgrave Square	1	227	Charing Cross	2	848
Berkeley Square	1	1437	Consumption ... Fulham Road, Brompton	—	1395
Bethnal Green St. John's Church, Cambdg. Rd.	6	114	German	6	164
Bishopsgate Street	4	937	Great Northern	4	752
Blackfriars Road	3	849	Guy's	4	518
Bloomsbury Square	2	1643	King's College	2	1603
Boltons, The (N.W. Corner) West Brompton	1	185	Lock	2	325
Bond Street	2	140	Lock	2	816
Bond Street	1	1280	London	5	783
Borough High Street .. St. George's Church	3	1750	London Fever.. Liverpool Road, Islington	4	1207
Brecknock Road	4	1169	Lying-in	2	1046
Brixton St. Matthew's Ohurch, Brixton Road	4	1589	Lying-in, General .. York Road, Lambeth	2	1561
Broad Street High St., St. Giles's, Bloomsbury	2	1026	Lying-in, London	4	1296
Brompton	—	1605	Lying-in, Queen's	1	1446
Brunswick Square.....	3	815	Middlesex .. Charles Street, Fitzroy Square	2	1074
Bryanston Square	1	1396	Royal Free	3	1209
Cadogan Place	1	180	St. Bartholomew's	3	1283
Camberwell Road	4	881	St. George's	1	180
Camberwell Green	4	864	St. Luke's	4	1123
Camden Town..Mother Red Cap, High Street	3	1355	St. Mary's ... Cambridge Place, Paddington	1	995
Camden Town..Cobden Statue, High Street	3	1171	St. Thomas's	2	1296
Cavendish Square	2	411	University	3	71
Chancery Lane	3	308	Westminster	2	609
Charing Cross	2	650			
Cheapside	3	1588	Hyde Park Corner	1	140
Chelsea Hospital Chapel Entrance Queen's Rd.	1	592	Hyde Park Victoria Gate, Uxbridge Road	—	1710
Chester Square	1	850	Islington	4	504
Christ's Hospital	3	1212	Judd Street	3	1161
Clapham Common .. The Plough, High Street	4	3	Kennington Pk. Rd. Brixton & Clapham Rds.	3	973
Clapham Common S.E. Corner, Balham Hill Rd.	4	709	Kennington Road	3	890
Clapham Park .. Clarence Road, King's Road	4	1213	Kensington	—	1480
Clarendon Square	3	1225	Kensington Rd., Kensington Cres. (Centre)	1	1080
Clerkenwell Ho. of Correction, Cobham Row	3	1085	Kilburn	3	233
Clerkenwell Green	3	1567	King's Cross	3	1396
Coal Exchange	4	747	King's Road ..Chelsea, The Man in the Moon	1	665
Commercial Docks	6	1227	King's Road	1	16
Commercial Road East	6	930	Knightsbridge	—	1288
Corn Exchange	4	965	Ladbroke Grove	1	1674
Covent Garden Market	2	1043	Lambeth Bridge	2	995
Cumberland Terrace, centre of, Regent's Pk.	3	460	Lambeth Baths .. Westminster Bridge Road	3	26
Custom House	4	865	Lambeth Palace	2	1396
Dorset Square	2	229	Leadenhall Street	4	739
Downing Street	2	1040	Lincoln's Inn	3	36
Eaton Square	1	655	Lisson Grove	1	1551
Ebury Bridge	1	1122	Lombard Street	4	384
Eccleston Square	1	1422	London Bridge	4	549
Edgware Road	1	1109	London Docks	5	103
Elephant and Castle	3	1198	Long Acre	2	608
Euston Road	3	20	Loughborough Road .. Cold Harbour Lane	4	1593
Euston Square	3	464	Lower Wandsworth Road .. Queen's Road	2	650
Finsbury Square	4	1207	Lowndes Square	—	1455
Fitzroy Square	2	1453	Ludgate Circus	3	719
Fleet Street	3	350	Maida Hill .. Aberdeen Place, Edgware Road	2	397
Fulham Road	1	1220	Manchester Square	1	1652
Gloucester Road	—	1255	Mansion House	4	160
Gloucester Square	1	464	Marble Arch	1	976
Golden Square	2	189	Marylebone Road .. St. Marylebone Church	2	723
Gray's Inn Gate	3	386	Marylebone Road	2	1314
Grosvenor Place	1	483	Metropolitan Cattle Market .. S.E. Corner	5	103
Grosvenor Square	1	1471	Mill End Road	5	1103
Grosvenor Gate	1	1298	Mill End Road	6	623
Guildhall	4	213	Mint	4	1503
Hackney	6	1314	Montagu Square	1	1528
Hamilton Terrace Abercorn Pl., St. John's Wd.	2	1477	Notting Hill	1	1068

[One Mile is 1760 yards.]

OMNIBUS FACILITIES for VISITORS to the EXHIBITION.

THE OMNIBUS SERVICES.

- | | | |
|--------|---|---|
| WHITE. | { | PUTNEY TO LONDON BRIDGE, viâ Fulham Road, Piccadilly and Strand, from 7.40 a.m. to 10.50 p.m., every 10 minutes. |
| | | LONDON BRIDGE TO PUTNEY, from 9 a.m. to 12.20 midnight, every 10 minutes. |
| | | WALHAM GREEN TO LIVERPOOL STREET, viâ same route, from 7.45 a.m. to 10.55 p.m., every 10 minutes. |
| | | LIVERPOOL STREET TO WALHAM GREEN, from 8.50 a.m. to 12.10 midnight, every 10 minutes. |
| BLUE. | { | QUEEN'S ELM TO ISLINGTON, viâ Piccadilly, Regent Street, Marylebone Road, Euston, St. Pancras and King's Cross Stations, from 8.20 a.m. to 12 midnight, every 8 or 9 minutes. |
| | | ISLINGTON TO QUEEN'S ELM, from 8.10 a.m. to 11.55 p.m., every 8 or 9 minutes. |
| | | QUEEN'S ELM TO HOLLOWAY, viâ same route, from 8.24 a.m. to 10.30 p.m., every 8 or 9 minutes. |
| | | HOLLOWAY TO QUEEN'S ELM, from 8.20 a.m. to 10.50 p.m., every 8 or 9 minutes. |
| RED. | { | HAMMERSMITH TO LIVERPOOL STREET, viâ Kensington High Street, Knightsbridge, Piccadilly and Strand, from 8 a.m. to 10.35 p.m., every 4 or 5 minutes. |
| | | LIVERPOOL STREET TO HAMMERSMITH, from 9.15 a.m. to 12 midnight, every 4 or 5 minutes. |

HAMMERSMITH Omnibuses pass the Albert Hall Entrance to the Exhibition, all others come to the Cromwell Road.

Additional Omnibuses will be put on the Putney, Walham Green and Hammersmith Lines early in May.

THE ROAD CAR SERVICE.

Commencing with the 4th of May (the Opening Day), the Cars of the LONDON ROAD CAR COMPANY will run between Liverpool Street (Great Eastern) and Broad Street (North London) Stations in the City, viâ Broad Street, Queen Victoria Street, Ludgate Hill, Fleet Street, Strand, Trafalgar Square, Regent Street or Haymarket, Piccadilly, and Fulham Road to the End of Exhibition Road, and *vice versâ*. The Cars will leave Liverpool Street and Broad Street Stations every five minutes between 8 a.m. and 10.45 p.m., and return from Exhibition Road in the same manner.

THE TRAM CAR SERVICE.

Omnibuses in connection with the South London Tramways Company's system, which embraces Battersea Park, Wandsworth Road, Clapham Junction, Nine Elms, Chelsea Bridge, Wandsworth, Lavender Hill, &c., will run at frequent intervals between Battersea Park and the International Inventions Exhibition, arriving at and departing from the South End of Exhibition Road.

For further particulars of Train Service, &c., see the 'Official Railway Guide and Route Table,' Price One Penny.

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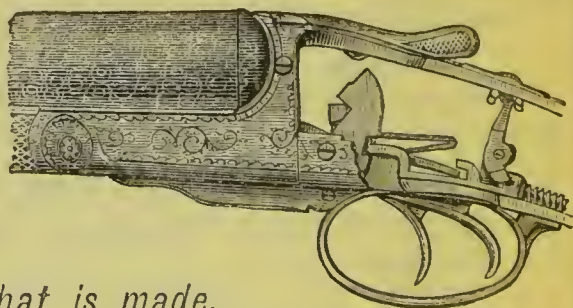
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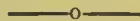


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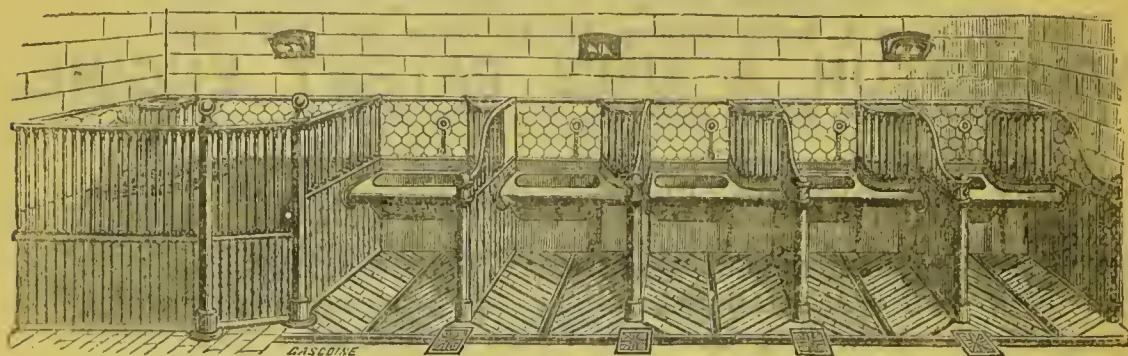
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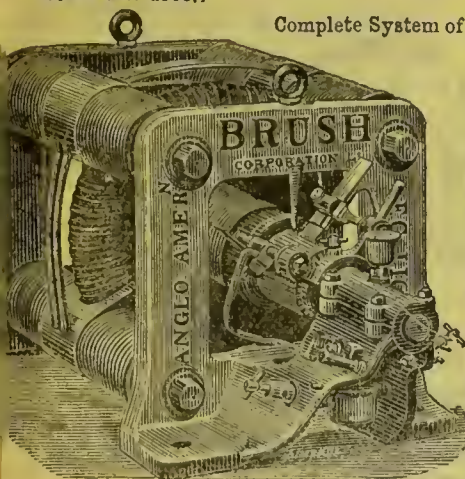
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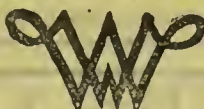
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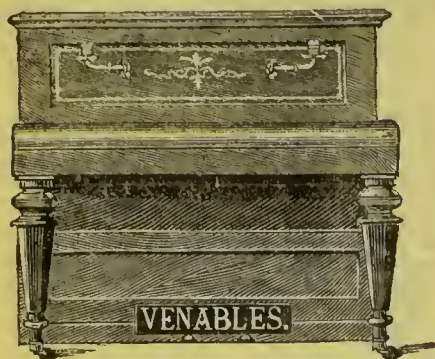
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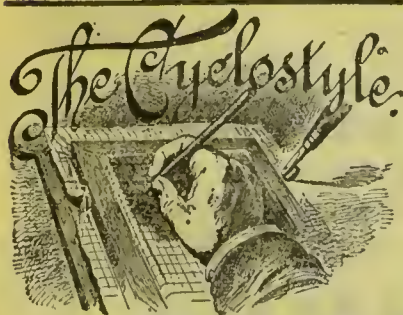
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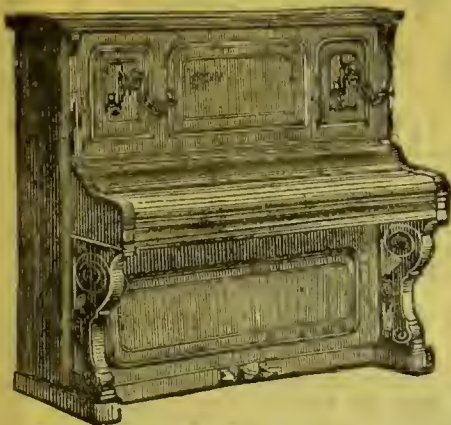
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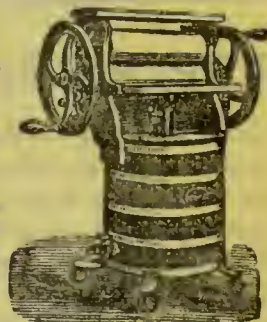


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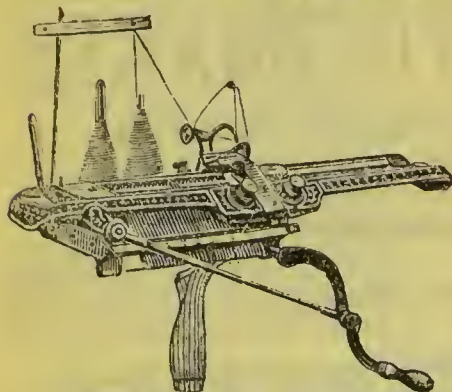
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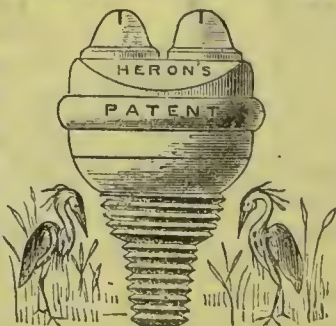
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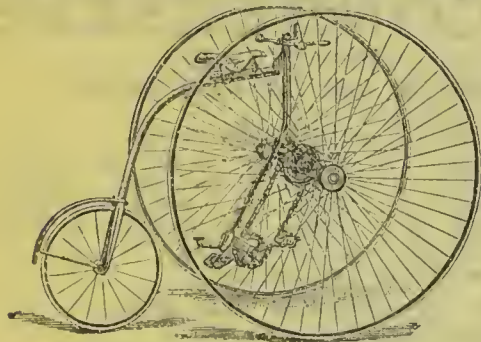
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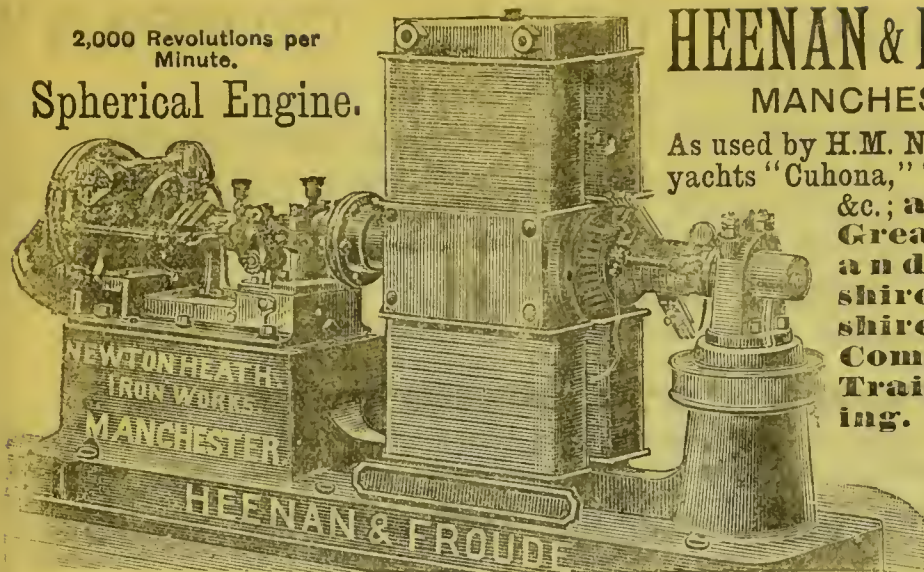
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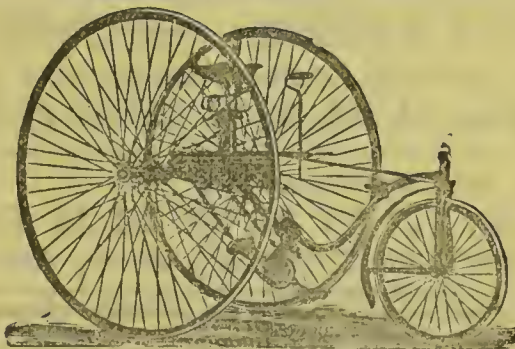
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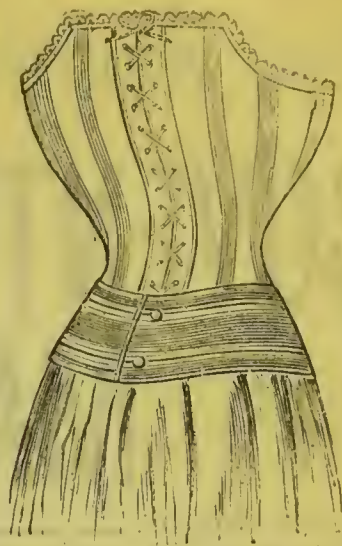
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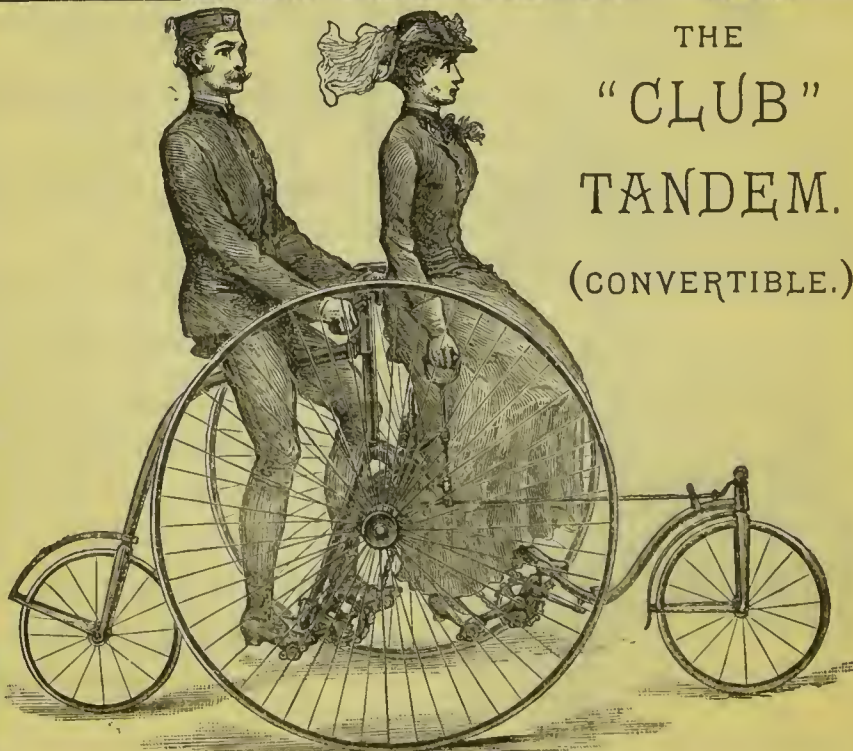
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